VOLUME XXI AUGUST, 1938 NUMBER 8

JOURNAL OF DAIRY SCIENCE

PUBLISHED BY THE
AMERICAN DAIRY SCIENCE ASSOCIATION

Contents

Pedigree promise and progeny test among sires proved in Iowa cow testing association. JAY L. LUSH and EARL N. SCHULTZ 421

Observations on the splitting of brick cheese. F. E. HANSON, D. W. SPICER and W. V. PRICE 433

Seeding test for crystalline beta lactose. P. F. SHARP 445

Physical state of lactose as influencing the determination of moisture in dry milk products by the toluene distillation method. PAUL F. SHARP, HUGO DOOB, JR. and RAY G. HART 457

The effect of gelatin on the curd tension of milk. RUTH E. L. BERGGREN 463

The lipase, fatty acid and cholesterol content of cow's blood in relation to the production of rancid milk. RUTH REDER 475

Coffee as a factor in the feathering of cream. P. H. TRACY and W. J. CORBETT 483

The Thirty-Third Annual Meeting of the American Dairy Science Association 497

Abstracts—Milk and Milk Products 213

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The Journal of Dairy Science **is issued monthly. Subscription is by the volume and one volume is issued per year.**

Manuscripts **should be typewritten and carefully revised before submission to A. C. Dahlberg, New York Agricultural Experiment Station, Geneva, New York. Twenty-five reprints will be furnished gratis to authors. Cost of additional reprints and reprint order blank will be submitted with proof.**

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Advertising **should be mailed direct to the Science Press Printing Company, Lime and Green Streets, Lancaster, Pennsylvania.**

Correspondence **regarding business policies of the Journal should be addressed to the Secretary-treasurer, R. B. Stoltz, The Ohio State University, Columbus, Ohio.**

JOURNAL OF DAIRY SCIENCE

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PEDIGREE PROMISE AND PROGENY TEST AMONG SIRES PROVED IN IOWA COW TESTING ASSOCIATIONS[1]

JAY L. LUSH AND EARL N. SHULTZ

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Bulls which were proved in Iowa Cow Testing Associations, according to the rules of the Dairy Bureau in effect before 1936, were studied to see (1) how many of their parents and grandparents had been tested for production and (2) how closely the production testing in the bull's pedigree indicated either the average production of his daughters or the average increase of his daughters over their dams. This study was confined to the 303 Holstein-Friesian sires (which constituted about half of all sires proved) so that differences in breed averages would not obscure the intra-breed situation, which alone is of practical interest to the breeder who follows a policy of pure breeding or of consistently grading toward one pure breed. We see no *a priori* reason to suppose that the relation between pedigree promise and progeny performance would be different in other breeds.

Each bull had at least five tested daughters out of cows also tested in C.T.A. herds. About half of the bulls had *only* five such daughter-dam pairs. Less than one-fifth of them had more than eight pairs. For the present study the average fat production of the daughters (or of the mates[2]) of each bull was treated as a single item, regardless of the number of daughters (or mates) in that average. About half of the bulls were proved by association-year records; that is, by using as the measure of the cow's production her total production during the twelve months of the association year, regardless of her stage of lactation or lactations. The others were proved by lactation records; that is, by using for the cow's production her production during her whole lactation, or during the first 365 days if her lactation was longer than that. The association-year records were corrected to maturity by considering the two-year-old record as 70 per cent, the three-year-old record as 80 per cent, and the four-year-old record as 90 per cent of the mature record. The lactation records were corrected to maturity by the Bureau of Dairy Industry

Received for publication December 13, 1937.

[1] Journal paper No. J-510 from the Iowa Agricultural Experiment Station.

[2] The dams of the bull's daughters are hereafter called the bull's mates, to distinguish them from the bull's own dam.

factors now in general use. When a cow had more than one record the highest was used. No case was included where the daughters or mates were known to have been milked more than twice a day but, as the number of times milked was not noted on the earlier reports used in proving sires, a few such cases may be included.[3]

As production records for the bulls' parents and grandparents we used only Advanced Registry records more than 305 days in length.[4] All such records completed before the end of 1936 were included. These records were corrected to the "mature B" basis (mature cows milked three times a day) by the factors used by the Holstein-Friesian association. Most of the tested dams and grandams of course had only one A.R. record. Where a cow had more than one A.R. record the average of those was used. For each sire and grandsire the average of the A.R. records of all his daughters was used as his A.R. test.

When the daughter average, the mate average and the average increase of each sire's daughters over his mates were each treated as single items, the means and standard deviations[5] of those items for these 303 sires were as follows:

	Pounds of butterfat	
	Mean	Standard deviation
Mates	416	78
Daughters	430	82
Increase	14	68

[3] Correlations between individual daughters and dams within the group used to prove each sire indicate that individual differences in the fat records were about one-fourth caused by hereditary differences between the cows. Differences in test (percentage of fat in the milk) were about one-half caused by hereditary differences between the cows. The lactation records and the association-year records seemed about equal in their accuracy as indicators of the cow's heredity (JOURNAL OF DAIRY SCIENCE 19: 429–430). A later study of 305-day lactation records used since 1935 in proving bulls in Iowa indicated that intra-herd differences in unselected single records of fat production were about 43 per cent permanent throughout the cow's lifetime and about 28 per cent hereditary (JOURNAL OF DAIRY SCIENCE 20: 440–441). We hope that these studies of heritability can be extended soon.

[4] Many of the dams and some of the grandams of these bulls had C.T.A. records, but those were not at that time systematically recorded in any one place where we could inquire what records existed concerning each cow or bull. We can only guess at the amount of C.T.A. testing in the pedigrees of these bulls. Among 1,055 bulls in use in Iowa C.T.A. herds in 1937, 45 per cent were out of C.T.A. tested dams and another 39 per cent were out of A.R. tested dams with 4 per cent being out of H.I.R. tested dams and only 12 per cent being from dams not tested at all. Since the 303 bulls studied here were from an earlier time (already proved before the end of 1935), it seems certain that the proportion of C.T.A. testing in their pedigrees was less than this, but we do not know how much less.

[5] These standard deviations and the correlations were corrected for what little heterogeneity there was between lactation and association-year records.

The correlations between these three items were as follows:

Mates and daughters	+.64
Mates and increase	−.38
Daughters and increase	+.47

The rather high correlation between the average of the bull's mates and the average of his daughters comes from two biologically diverse sources. The first is the genetic fact that daughters get half of their inheritance from their dams and hence tend to resemble those dams somewhat—a correlation which the process of averaging makes fairly high between *averages* of a bull's mates and *averages* of his daughters, even when it is low between *individual dam* and *individual daughter*. The second is the heterogeneity of management and feeding practices from one herd to another, whereby dam and daughter (which are nearly always tested in the same herd) would in many cases have had their records both raised or both lowered by the environmental circumstances characteristic of that herd but not of all herds. The negative correlation between mates and increase is only another way of expressing the well-known general tendency for offspring to regress from a parent toward the mean of the race, this regression itself resulting from two quite distinct causes. The first of these is that the size of a cow's record is affected by other things besides her breeding value and therefore the cows with the highest records generally do not have as good heredity as their records (if taken at face value) would indicate, while the cows with the lowest records generally are not quite as poor as their records. The other fact causing this regression is that the best cows are not always mated to the best bulls and the poorest cows are not always mated to the poorest bulls. The daughters, getting half of their inheritance from each parent, therefore generally tend to be poorer than their dams in the case of those with the very best dams and better than their dams in the case of those with the poorest dams. The positive correlation between the daughters and the increase is another way of expressing that same regression.

That the 14 pound average increase in one generation measures the true rate of genetic improvement in this population can hardly be maintained with confidence. Too many other possibilities may have affected this figure. For proving the sire only the best record was used when a cow had more than one, and many of the daughters had only made one record when their sire was "proved." Hence the records of the dams in general probably were a bit more highly selected than the records of the daughters. There seems to be a general tendency for herds to improve their management with increasing experience in C.T.A. testing. In many cases the daughters made their records at a later date than their dams and would have been under better management. It is possible that greater effort was made to gather the "proof" on sires which were thought to be doing well than on those which were believed

to have been poor sires, even though the testers were urged to prove all bulls without regard to the level of that proof. These considerations lead us to think that this 14 pounds average increase is of little use as a guide to the rate of genetic change in this population.

The averages of the lactation-year records and of the association-year records, in pounds of butterfat, were as follows:

	C.T.A. year	Lactation year
Number of bulls	149	154
Mates' production	403	429 –
Daughters' production	431	429 +
Increase	28	1 –

There was very little difference in the production of the daughters. The C.T.A. year records mostly come from a slightly earlier period than the lactation records, although there was some overlapping in those dates.

DESCRIPTION OF PEDIGREES

Table 1 shows, as a composite pedigree, the averages and variabilities of the A.R. tests of parents and grandparents. About half of the sires, nearly

TABLE 1

Composite pedigree showing the amount of A.R. testing

303 Sires Proved in Iowa C.T.A.

Sires:
161 had A.R. daughters averaging 631 lbs.
$\sigma = 76$ lbs.
Quartiles:
580 and 682

Paternal Grandsires:
223 had A.R. daughters averaging 636 lbs.
$\sigma = 63$ lbs.
Quartiles:
594 and 678

Paternal Grandams:
55 had A.R. records averaging 731 lbs.
$\sigma = 109$ lbs.
Quartiles:
657 and 805

Dams:
62 had A.R. records averaging 645 lbs.
$\sigma = 105$ lbs.
Quartiles:
574 and 716

Maternal Grandsires:
116 had A.R. daughters averaging 619 lbs.
$\sigma = 71$ lbs.
Quartiles:
571 and 667

Maternal Grandams:
14 had A.R. records averaging 595 lbs.

three-fourths of the paternal grandsires, and more than a third of the maternal grandsires had A.R. daughters.[6] The averages for sires and for the two grandsires were nearly the same and the differences which did appear were statistically insignificant, although in the direction to be expected if such records actually do carry some weight in determining the buyer's choice of bulls.

The standard deviations of these sire tests are about the same for sires and both grandsires. Quartile values (computed from these standard deviations) are shown for convenient use in estimating at a glance whether a particular sire's daughters are extremely high-producing or only moderately so, as compared with daughters of other sires. These quartile values indicate closely enough for practical purposes the boundary between the lowest quarter and the next to the lowest quarter and the boundary between the highest quarter and the next to the highest quarter of the bulls.

The records of the dams and grandams indicate that the most intense selection in dairy cattle breeding is practiced in deciding which dams are good enough to have their sons saved (the high average of the dam) or to have their sons stand at the head of purebred herds (the very high average of the paternal grandams). The general average of all mature A.R. records in Class B in the Blue Book to the end of 1936 is 619 pounds of fat. Differences between this figure and the averages shown in Table 1 may perhaps indicate how slight after all is the selection actually practiced in favor of high production when bulls are chosen to head even such progressive C.T.A. herds as the ones in which these sires were proven.

The records of dams and grandams show larger standard deviations than the records of sires and grandsires. In most cases the sire's and grandsire's records are averages of several daughters, whereas many of the dams and grandams had but one record and few had as many as three. Averages are naturally less variable than single records. The lower variability of the records of male ancestors probably results automatically from the averaging process and does not indicate at all that the male ancestors vary less than the female ancestors in their breeding values. An additional indication of this is the fact that the averages of the bulls' mates in the C.T.A. records are about as variable as the daughter averages for the sires and grandsires.

PEDIGREE AS RELATED TO PROOF

For each ancestor in turn, the 303 bulls were grouped in two groups according to whether that ancestor was or was not A.R. tested. Table 2 shows the average production of mates and of daughters for each of these groupings. The most conspicuous feature of Table 2 is that the bulls with testing in their pedigrees were mated to cows of higher production than were

[6] It should be remembered that some of the others had C.T.A.-tested daughters, but the records of those were not assembled so that we could consult them.

TABLE 2

Differences in the performance of 303 sires according to whether they had or did not have A.R. testing in various parts of their pedigrees

Part of the pedigree concerned:		Averages pertaining to the proof of bulls whose ancestor was:		Difference
		Tested	Not tested	
Sire tested or not tested:	Number of bulls	161	142	
	Mates of these bulls	427	403	+24
	Daughters of these bulls	441	417	+24
	Increase	+14	+14	+trace
Dams tested or not tested:	Number of bulls	62	241	
	Mates of these bulls	444	409	+35
	Daughters of these bulls	444	427	+17
	Increase	−trace	+18	−18
Paternal grandsire tested or not tested:	Number of bulls	223	80	
	Mates of these bulls	421	401	+20
	Daughters of these bulls	435	417	+18
	Increase	+14	+16	− 2
Paternal grandam tested or not tested:	Number of bulls	55	248	
	Mates of these bulls	430	413	+17
	Daughters of these bulls	428	431	− 3
	Increase	− 2	+18	−20
Maternal grandsire tested or not tested:	Number of bulls	116	187	
	Mates of these bulls	431	406	+25
	Daughters of these bulls	435	427	+ 8
	Increase	+ 4	+21	−17
Maternal grandam tested or not tested:	Number of bulls	14	289	
	Mates of these bulls	437	415	+22
	Daughters of these bulls	458	429	+29
	Increase	+21	+14	+ 7

the other bulls. For all six ancestors, except the paternal grandam, those bulls with tested ancestors had daughters averaging higher than the daughters of the bulls from untested ancestors. Because both the mates and the daughters were higher producers where there was testing in the pedigree, the increase of daughters over dams was for four of the six ancestors less for the bulls which had testing in their pedigrees than for bulls without such testing. We interpret Table 2 as indicating that the men who have the higher producing cows pay more attention to selecting their bulls than do the men who have the lower producing cows. By this greater effort they maintain their production at a higher level but they do not make it rise toward still higher levels any faster than it does in the herds where the bulls do not have A.R. testing in their pedigrees. Doubtless there is considerable regression toward

the breed average, both downward from those which have unusually good pedigrees and upwards from those whose pedigrees seem very poor.

Since these sires were proven before the end of 1935, even the youngest of them must have been placed in service before the end of 1931. Many of them were initially selected years earlier than that. On the other hand in some cases the A.R. records in their pedigrees were not made until near 1936. Therefore the comparisons as made here between those with A.R. testing in their pedigrees and those without such testing, include information which the purchaser of the bull in many cases could not have known when he selected that bull.

Considering one ancestor at a time and taking all cases in which that ancestor was A.R. tested, we measured the correlation between the bull's performance and the A.R. test of the ancestor and found the facts shown in Table 3.[7] The question here is how closely the size of the A.R. record indicates a correspondingly good or poor performance of the bull in siring daugh-

TABLE 3

Correlations between the bull's daughters' production (average as in columns 4 and 5, or increase over dams as in column 6) and the A.R. tests of his ancestors

Ancestor whose test was correlated with the bull's performance	Number of bulls included	Approximate standard error of r	Bull's performance		
			Average of his daughters		Increase of his daughters over their dams
			Regardless of their dams	From cows of a given level of production	
Sire	161	.08	−.02	−.02	−.01
Dam	62	.13	+.24	+.11	−.06
Paternal grandsire	223	.07	+.06	+.10	+.11
Paternal grandam	55	.14	+.10	+.21	+.23
Maternal grandsire	116	.09	+.03	+.01	−.01

ters which average high in production or which produce more than their dams. None of the correlations in Table 3 are statistically significant. They are prevailingly positive, but small. The partial correlations between the performance of the bull's ancestor and the performance of the bull's daughters from cows of a given level of production, we think are a bit more dependable than the simple correlation coefficients as indicators of the relation between ancestor's record and bull's performance. The partial correlations are less likely to be distorted by possible relations between the level of testing in the bull's pedigree and the level of production of his mates.

[7] Corrected for the slight heterogeneity between lactation and association-year records.

We interpret Table 3 as indicating that the relation between the bull's pedigree and his performance is positive but slight. But in making this interpretation it must be remembered that here the ancestors are considered one at a time, whereas the purchaser of a bull may combine the high records of some ancestors and the low records of others in the same pedigree to arrive at some kind of a weighted estimate of the desirability of the pedigree as a whole. The correlation between such a weighted estimate of the pedigree and the bull's performance would usually be larger, although not vastly so, than the correlations between any one of the ancestors and that performance. We were not able to combine the record of sire and dam and grandparents into a single multiple correlation prediction equation for the bull's own performance, because so few bulls in these data had A.R. tests for all six of those ancestors. A second qualification bearing on this interpretation is that we are here correlating the pedigree record with the *observed* progeny performance. That the progeny test of the bull is not a perfect indication of his breeding value is evident from the fact that the progeny test based on his first five or first ten daughters may be different from a similar test based on his subsequent daughters. That is, in comparing a pedigree with the observed progeny test we are correlating one indication of the bull's breeding value with another indication of the same thing, neither indication being perfectly reliable although one may be more so than the other. Under such circumstances the correlation between either of those indications and the bull's true breeding value, if the latter could be measured accurately, would almost certainly be somewhat higher than the correlation of the one indication with the other. Taking all these things into consideration, we think these correlations give slightly too low an estimate of the real usefulness of the A.R. records in a bull's pedigree as indicating his breeding value.

DISCUSSION

In nearly half of our data the progeny tests of the bulls themselves include only five daughters. Only an eighth of our bulls were proved by as many as ten pairs of daughters and dams. The figures for sires and grandsires in our study included all the tested daughters of each, but in many cases this was as few as three and in but few cases did it go far above ten.

Our correlations are lower than those found by Copeland[8] or by Madsen[9] in the only other reports we have seen of studies closely similar to this one. They found correlations as follows between the average production of a bull's daughters (the production of the bull's mates not being considered) and the production records of the bull's near ancestors:

[8] Copeland, Lynn. 1934. Pedigree Analysis as a Basis of Selecting Bull Calves. Jour. Dairy Science 17: 93–102.

[9] Madsen, Karl. 1932. Inheritance of Milking Capacity. Nature, January 30, 1932.

	Copeland	Madsen	
	Lbs. fat	Lbs. fat	Lbs. milk
Sire's daughters	+.56	+.32	+.25
Dam's own records	+.33	+.18	+.17
Paternal grandsire's daughters	+.25	+.19	+.20
Maternal grandsire's daughters	+.43	+.26	+.19
Paternal grandam's own records	....	+.06	+.03
Maternal grandam's own records	....	+.17	+.11

There are several differences in the data studied. Perhaps the chief one is that Copeland and Madsen included only data on bulls which had at least ten tested daughters. In Madsen's data the average number of daughters per bull was 18 and the average number of records per cow among the dams and grandams was 5.5.

The larger numbers available for the studies of Copeland and Madsen should have tended to give their figures greater dependability and to make them fluctuate less but we cannot see that our figures would have been biased toward lowness by this reason. They might as well have been too large—the scantiness of the material would merely permit them to be more erratic. Our material corresponds closely to the situation which the bull purchaser of today must face. The figures we studied were as much information[10] as the prospective purchaser could get about this bull in early 1937.

It may be worth while to point out that these correlations should be compared not with perfect correlations (which are not to be expected in any case) but with what might be expected in the limiting case in which the differences between cows as revealed by their records or between bulls as revealed by their daughters' records are assumed to be *perfectly* hereditary. This depends in part upon the degree of assortive mating practiced among those animals which do get selected to be parents but, as all dairy breeders are striving for high production, only the fact that some breeders strive harder or more wisely than their fellows toward the common goal can give rise to assortive mating. This surely cannot be intense in the population as a whole. Not enough inbreeding or extreme outbreeding is practiced that this would alter the picture noticeably. Ignoring for the moment the traces of assortive mating and inbreeding which probably exist, the expected correlation between the record of the bull's dam and the average record of his daughters would rise from +.25 toward +.50 as the number of his daughters increased. Similarly the expected correlation between the average record of the bull's sire's daughters and the average record of the bull's own

[10] Except that we did not use 7-day and 30-day records which were more abundant in the older pedigrees, H.I.R. records which are beginning to be available in the pedigrees of young bulls, and C.T.A. records which until recently have not been assembled systematically at any one place and have mostly been left in the barn books of the C.T.A. member in whose herd they were made.

daughters would range from +.125 when each had but a single daughter toward +.50 if each had very many daughters. The correlations between the bull's daughters and his grandparents' records would be just half as large. If all of the bull's ancestors were thoroughly tested and if their records could all be considered at once, the expected correlation between the promise of the pedigree as a whole and the bull's actual performance would range up toward +.71, being restrained by the sampling nature of Mendelian inheritance from going higher than that.[11] The existence of some assortive mating causes the correlation expected when one ancestor is considered at a time to be somewhat higher but has little effect on the dependability of the whole pedigree. The assortive mating merely results in each ancestor indicating to some extent what the other ancestors will be. Therefore the assortive mating causes one ancestor by itself to be a more useful indicator than it would be under random mating but not so much additional information is gained by actually learning the facts about those other ancestors. Perhaps little is to be gained by discussing these abstract conditions further, since in actual practice we face the overwhelmingly important fact that the size of a cow's record or of a bull's daughter average, even under A. R. conditions, is much influenced by many things other than the cow's or bull's heredity and that many of these things are dependent on the herd management or environment in such a way that no amount of increase in the number of records or number of daughters tested will tend to equalize those environmental differences as between animals which are tested in different herds.

That a few of Copeland's and Madsen's correlations are higher than expected, even on the assumption of perfect heritability, might result from undiscounted time trends or from stratification of management practices whereby there may be a noticeable tendency for a buyer to get his bull from a breeder who manages and tests his herd according to somewhat the same standards as the buyer does. Or if the divergence of ideals between those who put type first and those who put production first is distinct (as differences in emphasis could make it, even when all breeders are paying some attention to both type and production) and if there are many holding each ideal, then the assortive mating thus introduced could raise the correlations with individual ancestors above the limits expected under the abstract conditions. It seems profitless to speculate farther in this direction now, but we do think it worth while to mention that some of Copeland's and Madsen's correlations are rather higher than the general evidence about heritability

[11] This is the multiple correlation to be expected between the genotype of an individual offspring and the genotypes of its two parents in a population mating at random. No amount of knowledge about the ancestors can lead farther than toward a perfect knowledge of the genotypes of the two parents. See Genetics 6: 111–161 for more details concerning these biometrical relations.

of differences in milk and fat production leads us to anticipate, whereas our own coefficients are somewhat lower than we had anticipated.

The practical implications of these studies are that pedigree promise is worth something in selecting a bull but as a cold-blooded business proposition it should not be valued too highly. As a usual thing the prospective purchaser can reasonably expect to get in the daughters of his bull only a small part of that superiority over the rest of the breed which his bull's parents and grandparents showed. Often the pedigree is almost the only guide which the purchaser has, besides seeing that the bull meets his minimum standards of type and health. Like the weather forecasts, pedigree promise has some value, even if it isn't infallible! But, just as the traveler on a day when fair weather is predicted may take along an umbrella or raincoat if it doesn't cause too much expense or trouble, so the purchaser of a bull with even an extraordinarily good pedigree may find it best to sample the bull fairly and wait to learn the results before be builds his breeding plan too extensively around that bull, if the cost of sampling and waiting isn't too large. The more one knows about the conditions under which the records in the pedigree were made and allows for the differences which those conditions made in the records, the more accurate the pedigree becomes as an indicator of the bull's breeding value, but this is sharply limited both by the fact that one cannot make absolutely perfect allowances for those conditions, no matter how well he knows them, and also by the biological limits which the sampling nature of inheritance places on the accuracy of pedigree estimates. The existence of these distinct limits makes the law of diminishing returns apply to the effort spent in detailed study or standardizing of pedigrees. It is often worth while to find out the main features about the conditions under which the bull's ancestors were tested—*e.g.*, whether their records are selected ones or life-time averages, what the average production of the other cows in the herd was in the same years, whether they were milked oftener than twice a day, and roughly how well they were fed—but one quickly comes near the point where further study of these details will improve the accuracy of the pedigree estimate so little that such further study is scarcely worth the trouble.

SUMMARY

A study of the pedigrees of 303 Holstein-Friesian bulls proved in Iowa Cow Testing Associations before 1936 showed:

1. That the bulls with A.R. testing in their pedigrees were used in higher producing herds and had higher producing daughters than the bulls without such testing but, because of the higher production of their mates, the bulls with testing in their pedigrees did not increase the production of their daughters any more than the others did.

2. The correlations between ancestor's A.R. records and the bull's progeny performance were prevailingly positive but were so small as to be statistically insignificant on the amount of data available.

Although so limited in amount as to make them subject to large sampling errors, the data are compatible with the general conclusion that it is desirable to select bulls which have tested ancestors and whose tested ancestors have high records but that one can expect to gain in the daughters of such bulls only a small fraction of that superiority which their tested ancestors showed, as compared with the breed average.

OBSERVATIONS ON THE SPLITTING OF BRICK CHEESE

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At certain seasons of the year, a very characteristic defect may appear in Brick cheese when it is seven to fourteen days old. Excessive development of gas in the cheese causes holes which commonly become large enough to split the cheese. This defect is sometimes called "late-gas" in order to distinguish it from the gas which occasionally forms during the making or draining processes. The defect may appear in one part of a cheese as shown in figure 1, or it may extend throughout the length of the cheese, as

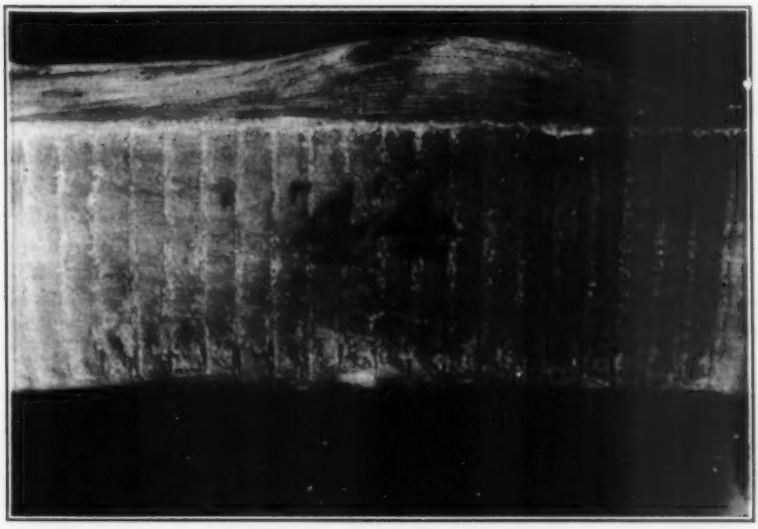

FIG. 1. Swelling of the cheese in a small area may occur when the gas development is localized. (The cheese is about 3 in. high at the edge. The whole cheese is not shown in this picture.)

illustrated in figure 2. A typical cross section of a defective cheese is shown in figure 3. This figure illustrates not only the splitting but also the "sweet" holes, which are sometimes associated with the splitting. Frequently a flat, metallic flavor appears in the cheese, even before the swelling occurs; at other times the cheese has a rather pleasing, sweet flavor. The defect has been observed most frequently in Winter and early Spring.

Received for publication February 26, 1938.

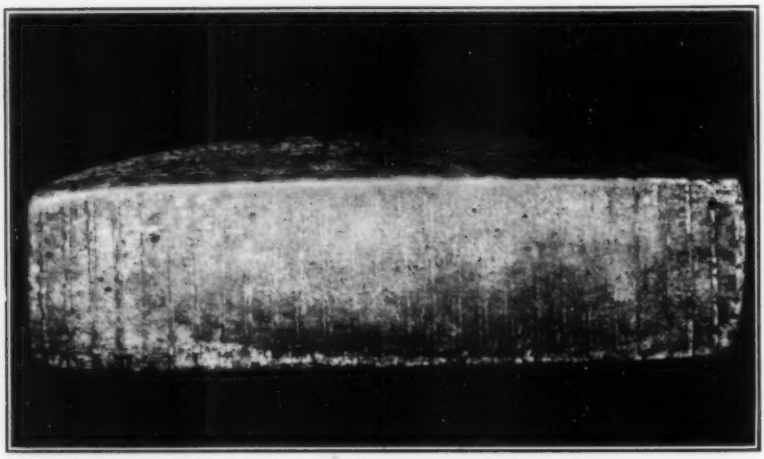

FIG. 2. Swelling of the cheese may take place throughout the entire length of the cheese when gas development is general. (The length of the cheese is 10 in.)

It occurs in some factories year after year, sometimes affecting all and sometimes only a portion of each day's make. Such cheese cannot be readily sold on the retail market.

It has been possible to observe the defect in this laboratory and in com-

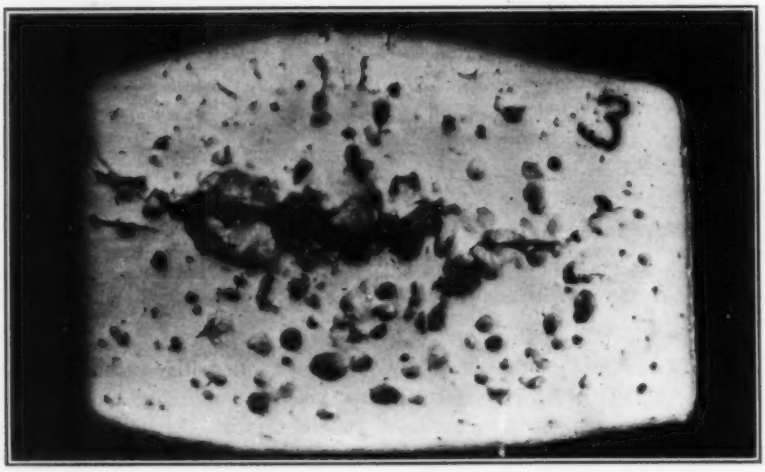

FIG. 3. A cross section of a cheese showing the splitting defect and numerous gas holes. (The size of the cheese section is approximately 3×5 in.)

mercial plants from time to time during the past six years. It is the purpose of this discussion to point out some of the conditions which seem to be associated with its occurrence in the cheese.

When the defect was first observed in our manufacturing laboratory, special precautions were taken to sterilize all cheese equipment and to change the starters used in the manufacture of the cheese. Milk for cheese making was pasteurized and every precaution was taken to avoid subsequent contamination. Despite these precautions, the cheese continued to develop the characteristic splitting. Process cheese made from this defective cheese also developed a similar type of fermentation. Undoubtedly the milk from which the cheese was made contained the responsible organisms when it was delivered by the farmers, and ordinary pasteurizing temperatures failed to destroy them.

EXPERIMENTS FROM 1933 TO 1935

It seemed probable that the gas-producing organisms were spore-forming anaerobes. Samples of the gassy cheese were, therefore, ground and placed in flasks containing sterile milk, to which a small amount of reduced iron had been added. These flasks were incubated at 37° C. for 15 hours. Such violent fermentations occurred in several of the flasks that the cotton plugs were dislodged. A number of pure cultures of spore-forming anaerobes were eventually obtained from these sources. Mixtures of several of the more active of these cultures were used to inoculate milk for cheese when it was considered necessary to obtain the defect. The futility of such inoculations was discovered eventually when controls as well as inoculated lots developed the defect.

From 1933 to 1935 several conditions of manufacture were studied, including: variations in the ripening of milk for cheese making; the type of starter; temperature of heating; time of dipping; moisture content of the cheese; methods of salting; the amount of salt in the cheese and the effects of pasteurization. These experiments will not be discussed in detail, but some of the more interesting relationships will be indicated.

Varying the time of ripening the milk before setting was carried to an extreme by holding the milk, to which normal amounts of *S. lactis* starter had been added, for two hours at the setting temperature before adding the rennet. The unripened milk was mixed with the necessary amount of rennet immediately after the starter was added. The ripened milk usually developed maximum or excessive amounts of acid, but the cheese was closer in texture, as might be expected, than that made from the unripened milk. Several lots of cheese from both ripened and unripened milk, however, were criticized for gas development and splitting.

S. lactis, L. bulgaricus, and *S. thermophilus* cultures were used in paired experiments in 1933. Each starter culture was used alone in pasteurized

milk, and utmost care was taken in the manufacturing process to prevent transfer of organisms from one vat to another.

The results indicated that the formation of excessive gas in the cheese after a week or more of curing might result in two distinct types of open-texture defect, depending upon the acidity of the cheese itself rather than upon the acid-producing organism used as starter. Cheese made with *L. bulgaricus* had the greatest and that made with *S. thermophilus* the least acid development. Cheese containing *L. bulgaricus* showed the splitting defect; that made with *S. lactis* showed both splitting and excessive gas formation; while the use of *S. thermophilus* culture tended to develop cheese with many very large holes but with practically no splits. High acid development had a slight suppressing effect upon the formation of gas. Apparently the short-bodied, acid-type cheese tended to split easily following an excessive gas formation which, in sweet cheese with more elastic body, only produced large gas holes. When splitting occurred in sweet cheese, it was preceded by the formation of large holes which finally broke into the characteristic splits when the elastic limit of the cheese was exceeded.

It is usually supposed that high moisture in cheese tends to exaggerate fermentation defects. This does not seem to apply, however, to the splitting defect. Moisture was regulated by changing the time of dipping and by using different temperatures of heating. The results indicated that the differences could be attributed more to the extent of acid developed than to the amount of moisture remaining in the cheese. For example, when the time of dipping was varied, the moisture content of the cheese ranged between 37.7 and 42 per cent. The lowest texture score was given cheese with a moisture content of 38.7, and the best score to cheese with 42 per cent moisture. In general, whenever the conditions of manufacture in these experiments induced the production of a sweeter type of cheese, the judges found more of the characteristic openness than in lots made from identical milk in which more acid was developed during the manufacturing process.

The effects of salt were studied on three different days by dividing the cheese from one vat into four groups. Each group was given a different salting treatment so that the average salt content of the lots of cheese in these four groups averaged 2.0, 2.4, 2.5 and 2.9 per cent. These differences were obtained by exposing the cheese for different periods of time to the brine and by varying the washing treatments by using brine for one group and fresh water for another. All four groups showed some gas defects because the pasteurized milk from which the cheese was made had been inoculated with cultures of anaerobic gas-forming types of organisms. The groups which averaged 2.0 and 2.4 per cent salt were regarded as less desirable in texture by the judges because of the presence of the late-gas and splitting defect in some of the cheese in these groups.

The association in this experiment of the defective texture with the

lower salt groups suggested that the size of the cheese loaves, one of the commonest causes of variations in salt in Brick cheese, might be a significant factor in relation to the defect. Measurements in 1934 and 1935 of texture, salt and thickness of loaves before salting were available on fifty-five lots of cheese made, not only during studies of the gas-defect, but during other experiments as well. Averages of these values are summarized in Table 1. The trends of the average values shown in this table indicate that

TABLE 1

Relation between texture score and the average thickness of loaves and salt content of Brick cheese

Texture score*	No. of lots	Thickness	Salt content
		inches	%
Below 2.0	1	1.38	3.93
2.0–2.9	17	2.60	3.16
3.0–3.9	25	2.64	3.29
4.0–4.9	10	2.80	2.96
Above 5.0	2	2.63	3.05

* 1=excellent; 2=desirable; 3=satisfactory; 4=objectionable; 5=very objectionable.

when the thickness of the cheese increases, there is a loss in texture score. This loss can be attributed to all defects, including "splitting." It is interesting that the lowest average salt contents in this table tend to be associated with the cheese of inferior texture. The thickness of the cheese, however, is apparently more closely related to the texture score than is the salt content. This may be explained by the relation between thickness of cheese and the formation of mechanical and gas holes.

Mechanical holes in Brick cheese are probably first formed by the trapping of free whey between curd particles. Gradually the whey escapes between the curd particles or is absorbed by the curd as it cools. If the whey is released before the curd cools too much, the curd flows into and closes, or partially closes the cavities left by the whey. Since whey escapes more rapidly from small loaves of cheese, such loaves would be expected to have fewer mechanical openings than large loaves.

In a similar manner, it is to be expected that more of the gas formed in small cheese would diffuse through it and escape without forming holes. These combined facts partially explain the relative freedom from either mechanical or gas holes of the layer of curd immediately beneath the rind of the cheese pictured in Figures 1, 2 and 3.

The use of salt to control fermentations is generally known in the food industry and is appreciated in the manufacture of some varieties of cheese. Swiss cheese makers, for example, practice salting heavily those spots on a cheese which show excessive swelling in order to check the formation of gas under that area. Since large loaves of Brick cheese become permeated

with salt more slowly than small loaves, it is logical to assume that salt might have a greater inhibiting effect on gas development in the small loaves of Brick cheese.

Regulation of the size of loaves of Brick cheese is not always easy. Mechanically it is difficult to estimate the amount of free whey in the curd at dipping, and it is practically impossible to measure exactly the amount of curd placed in each mold. Sudden changes in weather cause differences in milk composition and acid development, which in turn influence the yield of cheese per hundred pounds of milk. Effects of such changes are difficult to predict so that it is not surprising to encounter variations in size of loaves. Actually trade demands may require loaves of a certain thickness or weight which might actually favor the occurrence of the splitting defect.

Slight differences in late-gas development were observed in raw- and pasteurized-milk cheese when both lots were made from identical milk. Raw-milk cheese tended to develop somewhat more acid during the manufacturing process than did the pasteurized-milk cheese. When the raw-milk cheese developed the typical splitting defect, the pasteurized-milk cheese showed the same defect very slightly exaggerated by the presence of more of the large sweet holes. Actually, texture grades for these two types of cheese were practically identical.

The results of these early experiments indicated that, although no single factor was wholly effective, it might be possible, by regulating acidity, salt content, and size of the cheese to exercise some measure of control over the defect.

DEFECTIVE CHEESE FROM FACTORIES

During the winter of 1936–37, visits were made to a Brick cheese factory which was experiencing considerable trouble with late-gas formation. From 15,000 to 25,000 pounds of milk were being made into cheese each day. Only a portion of the cheese developed the splitting defect; the rest of it was entirely satisfactory and of high quality. The defect was not accompanied by undesirable off-flavor. The factory was visited at weekly intervals for

TABLE 2

Relation of average acidity and composition of Brick cheese at two weeks of age to late-gas formation

Degrees of defect*	No. of lots	Acidity	Moisture	Salt	$\frac{\text{Per cent salt} \times 100}{\text{Per cent } H_2O}$
		pH	%	%	
0	9	5.08	38.5	1.26	3.27
1	6	5.14	38.7	1.27	3.28
2	3	5.16	40.2	1.44	3.60
3	5	5.08	39.7	1.34	3.37
4	9	5.12	39.1	1.27	3.24

* 0 = none; 1 = slight; 2 = definite; 3 = pronounced; 4 = extreme.

several weeks, and samples of cheese, some of which were split, and some of which were satisfactory, were taken from the curing room at approximately ten days of age. These lots of cheese were scored and analyzed for acidity, moisture and salt. The results of these analyses are shown in Table 2. Of the 32 different lots of cheese examined, nine of them showed no splitting defect; six showed it slightly; nine lots were extremely bad. The analyses in Table 2 were made upon half-inch cross-section slices of each cheese and represent the composition of the cheese as a whole. In general, the average values for acidity, moisture and salt contents were practically the same for satisfactory and defective cheese. Since some of the satisfactory lots were taken from the same vats which produced defective cheese, it seemed possible that the defect might be caused by a treatment following the curd-making process itself.

In nine of the lots of cheese taken from the factory, analyses were made for acidity, moisture and salt on portions of the cheese removed from the center of the loaves. The results of these analyses are presented in Tables 3 and 4. The averages in Table 3 indicate slight differences in composition between the center portions and the cheese as a whole, both in acidity and

TABLE 3

Relation between late-gas formation and the average acidity and moisture in the whole cheese and in the center portion

Degree of defect*	No. of lots	Acidity		Moisture	
		Whole cheese	Center	Whole cheese	Center
		pH	*pH*	%	%
0	3	5.12	5.09	37.9	37.4
1	2	5.12	5.08	39.1	38.4
2	1	5.11	5.11	41.9	39.3
3	1	5.03	4.98	38.3	37.6
4	2	5.08	5.04	38.7	38.2

* 0 = none; 1 = slight; 2 = definite; 3 = pronounced; 4 = extreme.

TABLE 4

Relation between late-gas formation and the average salt content of the whole cheese and the center portion

Degree of defect*	No. of lots	Salt		$\frac{\text{Per cent salt} \times 100}{\text{Per cent moisture}}$	
		Whole cheese	Center	Whole cheese	Center
		%	%		
0	3	1.48	1.10	3.92	2.95
1	2	1.39	1.11	3.57	2.90
2	1	1.35	0.97	3.22	2.47
3	1	1.26	1.07	3.28	2.84
4	2	1.18	0.72	3.05	1.86

* 0 = none; 1 = slight; 2 = definite; 3 = pronounced; 4 = extreme.

moisture. Practically no differences exist between the acidities and moisture contents of the defective and satisfactory cheese. Table 4, however, indicates a generally lower salt content in the most defective cheese and distinct differences between the center portion and the whole cheese. This is even more noticeable when the salt content is stated as per cent of salt in the moisture of the cheese.

The factory operator was advised to increase the salt content of the cheese. Some practical difficulties arose in this connection. The length of time of holding the cheese in the brine could not be increased because the brine tank capacity was already being used to its utmost. The salt concentration of the brine was increased from 75 to 90 per cent saturation as measured by a salt hydrometer. Some of the lots of cheese still showed the splitting defect. This was attributed to the fact that double layers of cheese were floated in the brine tank, and the top layers, naturally, were less exposed to the brine than those beneath. A wooden lattice was made and placed over each layer of cheese as it was put in the brine. The layers were then submerged by weighting down the wooden lattice work. This exposed more cheese to the action of the salt. The defect was still not entirely eliminated, however. Observations of the handling of the cheese in the curing room disclosed the fact that occasionally fresh water from a hose was turned on the cheese after they were taken from the brine tank and while they were on the shelves in the curing room. This rinsing process removed the brine on the exterior of the cheese, reduced the salt content of the cheese and may explain why the defect still appeared from time to time.

These results tended to confirm some of the observations on the influence of salt that were made in 1934–35 and suggested that the typical splitting defect might be developed by special treatments of cheese which would normally be entirely satisfactory.

PRODUCING DEFECTIVE CHEESE FROM NORMAL LOTS

In the routine work of the laboratory, a considerable amount of experimental Brick cheese was being produced during the year 1936–37. All lots of cheese were normal and without late-gas defects. In order to verify the earlier observations and the results which seemed to be significant in factory practice, certain loaves of cheese were subjected to some treatment intended to influence the amount of salt in the cheese.

The first experiment consisted of placing a larger portion of curd than usual in the hoops at dipping on three different days in order to make excessively large cheese. Loaves weighing between six and seven pounds were produced in this manner as compared to the normal, which approximated five pounds in weight. Both large and normal cheese were treated in the usual manner accorded the normal cheese. Table 5 shows the results which were obtained when the cheeses were finally analyzed for salt and scored.

TABLE 5

Comparison of normal and large-sized cheese

Lot	Size of cheese	Per cent of salt	Late-gas
1	Normal	2.02	None
	Large	1.10	Definite
2	Normal	1.79	None
	Large	1.02	Many, large, sweet holes
3	Normal	1.91	None
	Large	0.99	Definite

The normal cheese contained more salt than the large cheese. In every instance the normal lots were satisfactory in texture while the large cheese either developed the splitting defect or developed so many large sweet holes that the loaves swelled almost to the splitting point.

In another experiment the amount of salt incorporated in the cheese was reduced by holding the cheese in the brine bath for 24 instead of the usual 48 hours. Typical results from three different days are shown in Table 6.

TABLE 6

Comparison of cheese salted 24 to 48 hours

Lot number	Hours of salting	Per cent of salt	Late-gas
1	48	1.70	None
	24	1.06	Definite
2	48	1.97	None
	24	1.30	Definite
3	48	1.57	None
	24	1.01	Definite

Here again the salt content of the normal cheese is higher than that of the abnormal cheese. In the cheese which was salted for 48 hours, the splitting defect did not occur. In the cheese salted for the shorter period of time, the splitting defect was noted in every instance. In those lots salted for 24 hours, the defect appeared even when the acidity of the cheese was in the range where cheese is criticized for excessive acid development. In those lots where the pH values were well above the acid limits, the splitting defect occurred to a greater degree. One lot of cheese weighing only 3 pounds 7 ounces and containing a relatively small amount of salt developed the splitting defect. The size of the cheese in this instance did not prevent the splitting defect when other conditions favored its occurrence.

DISCUSSION

The significance of the results of the experiments with late-gas formation from 1933 to 1935 was so doubtful at that time that they were not published.

Even now the chief reason for summarizing them is to show the reason for later observations and experiments and to emphasize the fact that more than one factor must be involved. Additional evidence of the importance of these other unknown factors is shown, for example, in Table 4 in which are presented much lower percentages of salt in satisfactory cheese than those associated with the splitting defect in the 1933 to 1935 experiments. More evidence of this same type was accumulated in 1936, when about forty factories in all Brick cheese producing areas of Wisconsin were visited at approximately monthly intervals from January until August, and loaves of cheese were brought to the laboratory for scoring and analysis. The frequency distribution of the salt analyses of the cheese is presented in Table 7. The

TABLE 7

Salt content of commercial Brick cheese collected between January and August, 1936, from 40 Wisconsin factories

Per cent salt in cheese	No. of samples
1.10–1.29	16
1.30–1.49	27
1.50–1.69	15
1.70–1.89	23
1.90–2.09	18
2.10–2.29	14
2.30–2.49	7
2.50–2.69	4
2.70–2.89	7
2.90–3.00	1

salt content ranges between 1.1 and 3.0 per cent. Observations in this laboratory would indicate that at least one-third of these lots of cheese contained so little salt that they should have been susceptible to the late-gas defect. Obviously, low salt content alone, however, cannot induce the defect if other conditions do not favor excessive gas formation. The reasons why some lots of cheese, despite the relatively low salt contents shown in tables 4 and 7, failed to show the late-gas fermentation are undoubtedly similar to those which determine the appearance of any gas defect in cheese. Small numbers, at least, of the causal organisms can usually be found in milk used for cheesemaking, but there are thresholds of acidity, temperature treatments and moisture contents which definitely limit their development. Such thresholds vary, however, depending upon the number, vitality and activity of the causal organisms. Low salt content, therefore, is regarded as only one, perhaps of several factors, which seem to make cheese more susceptible to the action of the organisms responsible for late-gas formation and splitting of Brick cheese. Certain conditions might be pointed out which seem to induce or to be associated with the development of late-gas, but for which no experimental evidence has been accumulated.

Organisms of the late-gas-forming type are undoubtedly essential for the

production of the defect. These gas producing organisms probably contaminate the milk on the farm, since even the most unusual precautions in the factory failed entirely to check this defect. It is probably true, also, that these undesirable types constitute a greater proportion of the milk flora during the periods when the herds are kept in the barns. When these organisms are present in sufficient numbers there is some reason to believe that the preventive measures mentioned in this discussion might be entirely ineffective. This is illustrated by the data in Table 1. Despite abnormally high salt content in that cheese the defect still persisted.

The general occurrence of the defect during the colder months of the year indicates that possibly the chilling of the curd during the dipping process may be partly responsible for the trouble. When the curd is dipped into the molds, it is customary to fill all the molds at first, then after the curd has settled slightly, the worker returns and adds to the molds sufficient curd to give the cheese its proper size. During this interval, cooling of the curd surface weakens its ability to knit together. Such a condition may even occur in the cooler days of Spring and Summer if the dipping is unnecessarily slow. The fact that the splitting of the cheese always occurs in the horizontal direction might be attributed to this manner of pouring the curd into the molds. It is a fact, of course, that the resistance to swelling is less along the horizontal plane of the cheese.

The common occurrence of the defect in Winter and Spring might be traced to the generally lower temperatures in the draining and salting rooms. Winter milk contains fewer lactic-acid-producing organisms. Factory starters frequently do not supply this need. As a result the cheese curd drains slowly and is frequently too sweet. Low temperatures in the draining room tend to delay necessary acid production. Low temperatures in the salt tank or salting room also tend to decrease salt absorption. It seems possible that such a combination of factors, at a time when contamination is naturally high, might be disastrous. The appearance of the defect in only a portion of the cheese made from the same vat of curd may be explained by variations in:—size of cheese, washing treatments, exposure to salt brine or temperature of cheese during the draining process.

Sometimes during the study of factory-made cheese, excessively large amounts of extraneous material were found. Frequently cow hair, bits of straw, or chaff from grain were found in the split portion of the cheese. The presence of such materials naturally weakened the curd structure and encouraged the splitting of the cheese at those points. It is probably true, also, that these bits of foreign material carried into the cheese excessively large amounts of those organisms responsible for the formation of the gas itself. Obviously, the presence of such foreign material is not to be condoned. A careful maker will not be guilty of permitting such substances

to get into the cheese vat, either through the milk itself or by exposure of the curd in the factory during the dipping operation.

SUMMARY

This report indicates that lack of acid development, low salt content and large loaves of cheese tend to encourage the development of late gas in Brick cheese. Although these factors are important they are not necessarily the only ones involved in the production of this defect.

SEEDING TEST FOR CRYSTALLINE BETA LACTOSE

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INTRODUCTION

Many times it is of great importance to know whether the lactose in a dried milk product is present as a glass or is in the crystalline state, and if in the crystalline state whether the crystals are alpha hydrate, beta anhydride, or both. This information can be obtained rather easily by taking advantage of the property of lactose to form fairly stable supersaturated solutions. Below 93° C., supersaturation with respect to alpha lactose hydrate predominates, and above this temperature, supersaturation with respect to beta lactose anhydride. If the concentration is so controlled that the solution is supersaturated with respect to one form and is undersaturated with respect to the other forms of lactose, advantage can be taken of the supersaturated state of the solution to test, by seeding, for the presence in the crystalline state of the form of lactose with respect to which the solution is supersaturated.

SEEDING TEST FOR CRYSTALLINE ALPHA LACTOSE HYDRATE

Hudson and Brown (1) described a test for crystalline alpha lactose hydrate based on this principle. They cooled from 20° C. to 0° C. a solution saturated with lactose, with the forms in equilibrium at 20° C., and used the solution for testing beta lactose preparations which were suspected of containing crystalline alpha lactose hydrate. Since crystallization proceeds slowly at 0° C., and such a temperature is not conveniently obtained in the laboratory, Troy and Sharp (2) used a modification of the test which is much more sensitive and convenient. A solution of lactose saturated at 50° C. with the forms in equilibrium was filtered, and cooled to 20° C. To each of several 10 ml. portions of this solution, in test tubes, was added about 25 mg. of test sample, and the tubes were stoppered and shaken. If alpha lactose hydrate crystals are present, the solution becomes turbid in about 15 minutes. If the solution remains clear for about one hour, the absence of alpha lactose hydrate crystals is indicated. Some idea of the amount of alpha lactose hydrate crystals or nuclei can be obtained by the time required to induce crystallization and by the degree of turbidity of the solution. The test is sensitive, and care in handling the solution is necessary to prevent contamination with crystalline alpha hydrate crystals; on the other hand a few perfect alpha lactose hydrate crystals when present may not induce copious crystallization of the solution. Dehydrated alpha

Received for publication February 17, 1938.

lactose hydrate also induces crystallization, because it hydrates before it dissolves, and the characteristic arrangement of the molecules of the sugar is not altered by simple removal of the molecules of water. Beta crystals and lactose in the glass form do not induce crystallization.

SEEDING TEST FOR BETA LACTOSE CRYSTALS

A seeding test for beta lactose anhydride crystals, based on the same principle, has been used in this laboratory for a number of years, and several hundred samples have been tested. In carrying out the test it is necessary that a solution supersaturated with respect to beta lactose and undersaturated with respect to alpha lactose hydrate be prepared and maintained for a period of time sufficiently long to determine whether crystallization can be induced by adding a small portion of a product suspected of containing beta crystals.

The test is carried out by means of apparatus of the type illustrated in

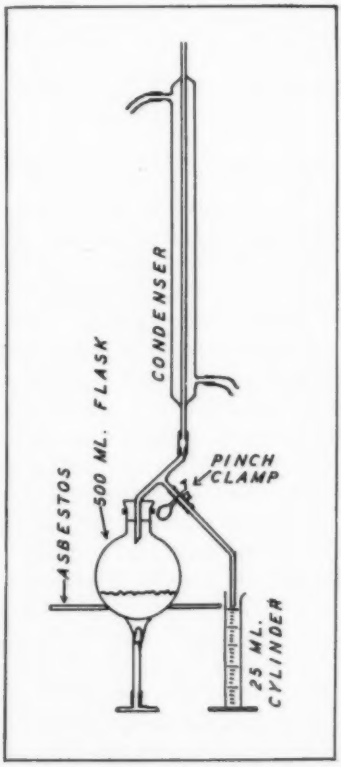

FIG. 1. Apparatus used for detecting beta lactose crystals in a product by its seeding effect on a solution supersaturated with respect to beta lactose.

Figure 1. A 500 ml. short-necked, round-bottom flask is attached to a condenser by means of a bent T tube, the stem of which is connected through rubber tubing and a pinch clamp to a 25 ml. graduated cylinder. It is possible to operate this apparatus either for refluxing or for the removal of solvent by distillation, by closing or opening the by-pass. No spattered solution should be permitted to dry on the inner walls of the flask above the surface of the solution, because this material will contain crystals of both alpha lactose hydrate and beta lactose. These crystals will eventually wash down into the solution and will induce crystallization. The drying is prevented by an asbestos guard ¼ inch thick, with a round hole of such a size that no direct heat from the flame is permitted to come near the surface of the boiling syrup.

To prepare the solution for the seeding test 58 ml. of water is added to 100 grams of alpha lactose hydrate in the flask, which is attached to the condenser in the refluxing position. In the early stages of heating the contents of the flask must be agitated by shaking to prevent the burning of the lactose. The solution should be boiled with the condenser in the refluxing position until all of the crystals have disappeared. The by-pass is then opened and 20 ml. of water is removed by distillation; the by-pass is then closed and the condenser is operated in the refluxing position. The portion of the T tube above the pinch clamp traps about 1 ml. of water. The solution in the flask is now supersaturated with respect to beta lactose anhydride and is undersaturated with respect to alpha lactose hydrate.

To carry out a test the stopper is removed and about 25 mg. of the material to be tested is knocked from a spatula into the flask. The stopper is then quickly replaced, and refluxing is continued. If the test material contains beta lactose crystals, the solution will become turbid in about 2 to 3 minutes. If the solution remains clear at the end of 10 minutes, the absence of beta lactose anhydride crystals is indicated. If the first sample tested does not induce crystallization at the end of 10 minutes, another sample can be added and the process continued until a sample is encountered which induces crystallization. After beta crystallization has been induced, it is necessary to reestablish the state of beta supersaturation. This is done by pouring down through the condenser the 20 ml. of water in the graduate. This dissolves the beta crystals in the flask. Again 20 ml. of water is distilled off, and the solution is then ready for further tests. The same solution can be used for about 2 hours. When a number of samples are to be tested, a battery of two or more testers may be operated at once. The testing can be shortened further by adding material from two or three samples at once to each flask. If at the end of 10 minutes crystallization is not induced, the absence of beta crystals in all of the samples is indicated. If crystallization is induced, then the samples must be re-tested individually to identify the specific ones containing beta crystals.

APPLICATIONS

Lactose. This method was first developed for testing products made in a study of methods of preparing beta lactose, particularly in relation to the importance of seeding, temperature, and the rate of removal of water from the solution as influencing the character of the product obtained.

It is difficult to prepare beta crystals entirely free from alpha crystals. The reason for this is that the beta lactose is crystallized from solution. The last trace of mother liquid or of the solution of lactose in the wash water adheres to the surfaces of the beta crystals. When the last bit of water is removed by drying, the water is removed faster than the forms can change and crystallize; consequently the solution becomes supersaturated with respect to both the alpha and the beta form, and they both crystallize out together on the surface of the beta crystals. Seeding tests, optical rotations, and moisture tests have indicated that this is true. A similar crystallization was found to occur on the surface of alpha lactose hydrate crystals. A number of samples of commercial alpha lactose hydrate were tested and they all gave tests indicating the presence of beta crystals. If, however, the crystals were moistened with a little water before being added to the test solution, crystallization was not induced. This small amount of water dissolved the beta crystals present on the surface of the alpha crystals before they were added to the supersaturated beta solution, and consequently crystallization was not induced. This demonstration of the presence of beta lactose crystals on the surface of ordinary alpha hydrate crystals raises an interesting point as to the purity of the alpha lactose used by investigators.

Dried milk. The samples tested included milk dried by the pressure and centrifugal spray, the vacuum and open roll, and the flake and old Campbell processes. In the nearly one hundred tests which have been run on freshly prepared products and products even ten years old which have been maintained at a low moisture content, the tests for beta lactose crystals have been negative.

If, however, the dried milk has been allowed to take up moisture and cake, the tests for beta lactose are usually positive. The lactose glass of the dried milk is diluted by the absorption of moisture to a concentration at which crystallization can occur; and since the solution is highly supersaturated with respect to both the alpha and the beta forms, under some conditions of time and moisture content both the alpha hydrate and the beta anhydride crystallize out together at room temperature.

Dried whey. Most of the methods of drying whey yield products in which beta crystals are absent. This includes: (1) the ordinary spray drying (glass); (2) partial drying by spraying (glass), maintenance of the product in a moisture-reinforced atmosphere (glass to alpha hydrate) followed by further drying; (3) spray drying (glass), rewetting, holding (glass to alpha hydrate) and finally redrying; and (4) evaporation to high

solids content, withdrawing from the evaporator, holding for several hours (supersaturated solution to alpha hydrate) and finally drying by tunnel methods. The greater hygroscopic properties of the dried whey probably accounts for the failure of the beta form to crystallize on caking in a similar manner to dried milk.

A new procedure for atmospheric roll drying has recently been developed which is continuous, does not involve a holding period, and results in a product in which the lactose is present largely as beta crystals. All samples of this product tested gave positive seeding tests for beta crystals.

Ice cream. A number of samples of ice cream were tested and none of them gave a positive test for beta crystals.

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PHYSICAL STATE OF LACTOSE AS INFLUENCING THE DETERMINATION OF MOISTURE IN DRY MILK PRODUCTS BY THE TOLUENE DISTILLATION METHOD

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INTRODUCTION

The measurement of the volume of water removed from a product by suspending it in an oil or an organic liquid which is immiscible with water, heating above the boiling point of water, distilling, and condensing the water, is frequently the most satisfactory method for the determination of moisture. In some procedures the liquid used is a nonvolatile oil the temperature of which is maintained considerably above the boiling point of water. This method is unsuitable for materials which decompose at the high temperatures necessary for the rapid removal of the water. Therefore a liquid with a boiling point slightly above that of water is selected, and both water and the immiscible liquid are distilled together, the lower temperature reducing decomposition by heat and the volatilization of the immiscible liquid aiding in sweeping out the water vapor. The vapors are condensed, the water is trapped out and measured, and the immiscible liquid is returned automatically to the distilling flask for redistillation. A method of this type was described by Dean and Stark (3), using xylene (boiling point 138–142° C.) as the immiscible liquid. Bidwell and Sterling (2) substituted toluene (boiling point 111° C.) for xylene, and modified the apparatus slightly to make it more suitable for food products. They used it for the determination of the moisture in a number of products, among them dried milk. Jones and McLachlan (6) preferred toluene to benzene or petrol as the immiscible liquid for the moisture determination on a number of food products. Wright (13) found the toluene distillation method more suitable than oven drying, for the determination of moisture in dried milk, and recommended a two-hour distillation time. The toluene distillation method has since met with general favor for the determination of moisture in dried skimmilk, and has been recommended by the Committee on Methods, of the American Dry Milk Institute (10) (11). Thompson and Fleming (9) made a careful study of the moisture values obtained by the toluene method and the method recommended by the Association of Official Agricultural Chemists (1). The latter consists in drying a 1.0–1.5 gram sample for 5 hours in a vacuum (less than 100 mm.) oven at 100° C., during which time two bubbles per second of dried air are

Received for publication February 17, 1938.

admitted. The toluene distillation method was found to be the more satisfactory by Thompson and Fleming.

Dried skimmilk is half lactose, and investigators have shown a tendency to consider that the removal of moisture from the lactose in dried skimmilk would follow a course similar to the removal of water from crystalline α lactose hydrate. Troy and Sharp (12) and Sharp (8) have shown that the lactose in spray dried, atmospheric roll dried, and vacuum roll dried milk powder is not crystalline but is present as a glass. Crystalline α lactose hydrate is present, however, in milk dried by the flake or old Campbell process, and in milk dried by the other methods after caking. Therefore a study of the removal of the water of crystallization from α lactose hydrate has a direct bearing only on the determination of moisture in these types of dried milk.

Dried whey has recently been produced in which a considerable part of the lactose is present as crystalline β lactose. Therefore the lactose is present in three different physical states in the different types of dried milk and whey, namely: as a glass, as the crystalline α hydrate, and as the crystalline β anhydride. The rate of removal of moisture from lactose is influenced by its physical state.

EXPERIMENTAL

The moisture in a series of samples of dried whey was determined by oven drying. The samples varied in lactose content, in the physical state of the lactose, and in acidity. Dried wheys show the differences in the physical state of the lactose more strikingly than dried skimmilks, because the amount of lactose present is greater. An air oven was used, as well as two types of vacuum ovens which differed in the degree of vacuum and in the method of applying the heat. The time of drying and size of sample were varied. In addition, moisture was determined by the Mojonnier procedure (Mojonnier and Troy (7)) which involves weighing the sample, dissolving it, drying it quickly, and weighing. In this procedure, the lactose is dissolved, and thus all forms are converted to the same physical state and dried as a glass. We found it difficult to get satisfactory duplicates when applying this method to dried whey. Darkening was variable and often considerable when using this method.

Since some of the these samples contained crystalline α lactose hydrate, a sample of about 160 mesh α hydrate was included each time with the other samples. A method, to be satisfactory for all samples, should remove all of the water of crystallization from the α lactose hydrate in order to avoid difficulties in checking and agreement between duplicates, and to express the moisture content of the various types of products on a comparable milk solids basis. It will be observed that the removal of the water of crystallization was complete or nearly complete in only a few cases.

Results obtained are reported in Table 1. This table also gives results

TABLE 1

Moisture content of dried whey as determined by several different proccdures

Whey sample no.	Total anhydrous lactose in whey	Fraction of total lactose as alpha (anhydrous)	pH	Vacuum oven pressure 1 mm. Central Scientific oven							Vacuum 27 in. Mojonnier		Air oven	Mojonnier dissolved	Toluene
				5 gm. 85° C. 5.5 hrs.	5 gm. 85° C. 22 hrs.	5 gm. 85° C. 41 hrs.	2 gm. 85° C. 17 hrs.	2 gm. 100° C. 3 hrs.	2 gm. 100° C. 16 hrs.	2 gm. 100° C. 16 hrs.	2 gm. 100° C. 5 hrs.	5 gm. 100° C. 15 hrs.	2 gm. 100° C. 15 hrs.	0.3 gm. 100° C. ½ hr.	50 gm. 111° C. 1 hour
	%(1)	*%(2)*	*(3)*	*%(4)*	*%(5)*	*%(6)*	*%(7)*	*%(8)*	*%(9)*	*%(10)*	*%(11)*	*%*(12)*	*%*(13)*	*%*(14)*	*%**(15)*
1	65.8	93.2	4.8	2.80	4.60	4.98	4.73	4.54	5.35	5.25	7.30	8.05	3.91	4.60	5.1
2	60.8	98.2	4.6	2.20	3.99	5.16	4.04	3.64	6.03	6.06	9.75	13.74	4.53	4.43	4.5
3	63.3	89.6	4.2	3.77	5.21	6.37	5.23	5.10	7.74	7.84	10.54	13.56	5.72	5.42	4.3
4	64.6	90.1	5.0	2.14	4.06	4.82	4.30	3.56	5.04	5.13	5.58	6.93	2.72	4.63	4.5
5	70.9	91.4	5.8	1.58	3.80	4.71	3.96	2.69	4.86	4.86	6.78	8.85	2.56	4.26	3.6
6	58.4	93.2	4.9	2.52	3.86	5.10	3.84	3.82	6.85	7.06	10.61	13.60	5.08	5.24	5.5
7	64.6	22.6	4.5	2.31	2.58	2.80	2.55	2.90	3.65	3.77	7.54	8.36	3.32	2.59	4.2
8	65.8	19.5	4.4	2.08	2.42	2.72	2.47	2.92	3.54	3.64	5.90	8.37	3.19	2.10	2.8
9	60.2	21.1	3.9	2.22	2.65	3.08	2.63	2.75	4.12	4.33	7.41	8.49	3.77	3.04	3.2
10	68.3	24.5	4.3	1.75	1.94	2.13	1.81	1.85	2.63	2.38	3.41	5.43	2.10	1.34	2.3
α lactose hydrate	95.0	100	.....	.82	2.71	4.50	2.86	1.92	4.80	4.95	5.01	5.18	2.22	3.87	4.2

* Duplicates not satisfactory.

** Before shaking during distillation was adopted.

obtained with the toluene distillation method. At the time these tests were made the technique of applying the toluene distillation method to dried wheys was rather unsatisfactory because of the settling out of the product, and burning. Later, when the toluene procedure was modified to give satisfactory results with dried whey, our supply of these samples was exhausted.

The results presented in Table 1 are variable and on the whole are not satisfactory. Moisture as determined by the different procedures does not always arrange the samples in the same order with respect to moisture content. Only in procedures (9), (10), (11), and (12) was the water of crystallization removed satisfactorily from the α hydrate. Some of the samples subjected to procedures (11) and (12) darkened greatly. The darkening was associated with high apparent moisture content. Procedure (9)–(10) was perhaps the best from the standpoint of satisfactory duplicates. Procedure (8) most nearly approaches the A.O.A.C. method, but it does not remove the moisture satisfactorily from the α hydrate. The vacuum was higher and the drying time shorter than in the A.O.A.C. method.

MODIFIED TOLUENE DISTILLATION

The Bidwell-Sterling type of apparatus was used with 50 gram samples and 120 ml. of toluene. Difficulty with burning on the bottoms of the flasks, due to settling, was encountered when the method was applied to dried whey. To prevent settling, the necks of the distilling flasks were firmly clamped to a long board which was suspended horizontally. One end of this board was connected to a motor-driven eccentric which gave a thrust of about $\frac{1}{4}$ inch, and operated at a speed of three or four revolutions a second, shaking the flasks violently during the distillation. Using this procedure, the maximum difference between duplicates rarely exceeded .2%. All of the determinations which follow were carried out using this method. The amount of water removed was measured at 10 minute intervals; the water adhering to the sides of the tube and condenser was loosened with a long wire before each reading. The toluene distillation method has the distinct advantage that the moisture-time relationship can be determined easily. This gives an insight into the factors contributing to the moisture content.

CRYSTALLINE LACTOSE

As expected, the rate of removal of water from crystalline α lactose hydrate depends upon the size of the crystals. This was shown for oven drying, by Herrington (5). It is equally true when the moisture is removed by the toluene distillation procedure, as is shown in Figure 1. Alpha lactose hydrate contains 5% of water of crystallization. A number of samples of dried whey and dried milk which contained α lactose hydrate crystals were suspended in a saturated lactose solution on microscopic slides. A microscopic examination indicated that some of the largest α lactose hydrate

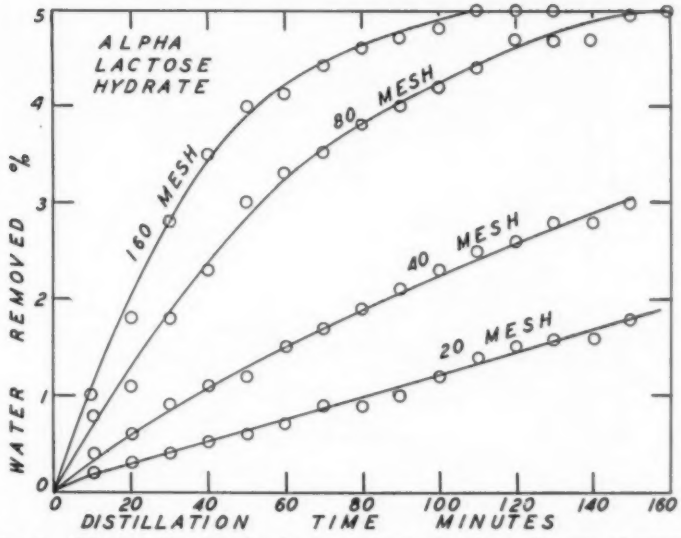

FIG. 1. Effect of the size of α lactose hydrate crystals on the rate of removal of moisture by the toluene distillation method.

crystals corresponded in size to the largest found in the 160 mesh lactose of Figure 1. Thus, a two-hour distillation time would be sufficiently long to remove the water from crystalline α lactose hydrate present in any ordinary dried whey or dried milk. The amount of moisture removed from the crystalline α hydrate increased with each ten-minute increment of distillation time up to 110 minutes for the finer crystals. The curves indicate a slow removal of moisture from the crystalline α hydrate. Pure β anhydride crystals gave no moisture when subjected to two hours of toluene distillation.

DRIED CASEIN

Quantitatively dried skimmilk is mainly an intimate mixture of dried lactose and dried casein. Consequently, moisture-distillation time curves were determined using several samples of dried casein. The results are presented in Figure 2. Here again size of particle was a factor in the rate of removal of moisture. With samples of 60 mesh, the break in the curve is fairly sharp, indicating that most of the moisture is removed in the first 60 minutes. Since the particles of casein are small in dried milk, these results indicate that any pronounced delay in removal of moisture from dried milk could hardly be attributed to the casein. This figure indicates that the toluene distillation method would be satisfactory for the determination of moisture in dried casein.

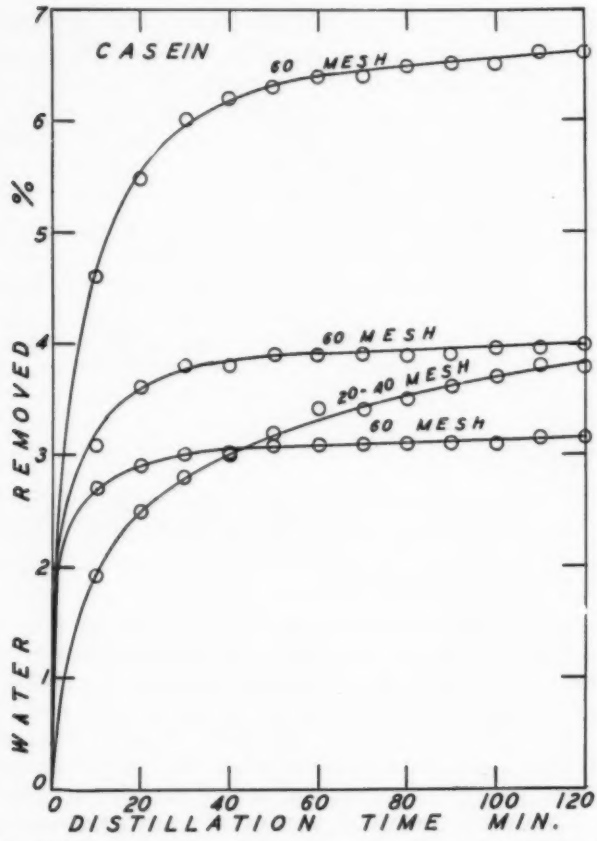

FIG. 2. Moisture content of commercial casein as determined by the toluene distillation method.

DRIED SKIMMILK

Lactose is present in the glass state in the fresh, spray dried, and roll dried skimmilks, and the curves presented in Figure 3, indicate that most of the moisture is removed from these types of dried milk in the first 60 minutes. This result is in agreement with the previous reports (9) (10) (11). For the samples prepared by the flake and old Campbell process, however, 60 minutes of distillation is not sufficient to remove all of the moisture. The shape of the curves is quite different because much of the lactose is present in the form of crystalline α hydrate. Approximately two hours of distillation is necessary for moisture determinations on this type of dried milk.

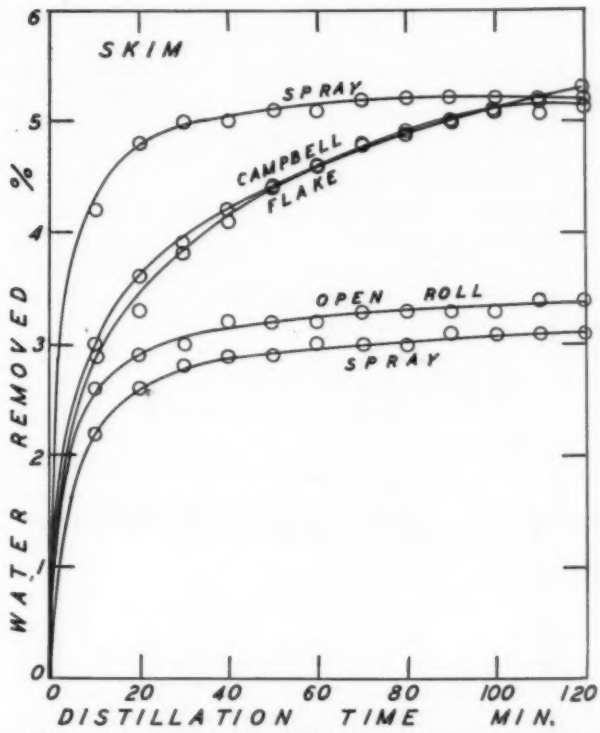

FIG. 3. Effect of the presence of crystalline α lactose hydrate (Campbell and Flake) on the rate of removal of moisture from dried skimmilk. Toluene distillation method.

DRIED WHEY

Typical moisture-distillation time curves for dried whey are given in Figure 4. The curves broke sharply with wheys in which the lactose was present as a glass or as crystalline β anhydride. Practically all of the moisture was removed in 60 minutes. The moisture was removed much more slowly from samples in which the lactose was present as α hydrate crystals, and a two hour distillation time was necessary for a moisture determination. The samples of whey in which the lactose was present as the α hydrate darkened during the distillation, and moisture, perhaps resulting from decomposition, continued to be given off slowly even when the distillation time was prolonged to three hours. The samples in which the lactose was present as a glass or as crystalline β lactose were a light straw color at the end of two hours.

The moisture content of spray dried whey (lactose in the glass state) cannot be determined by the toluene distillation method if the moisture content exceeds 3.5–4.0 per cent. Because of the syrupy state of the lactose,

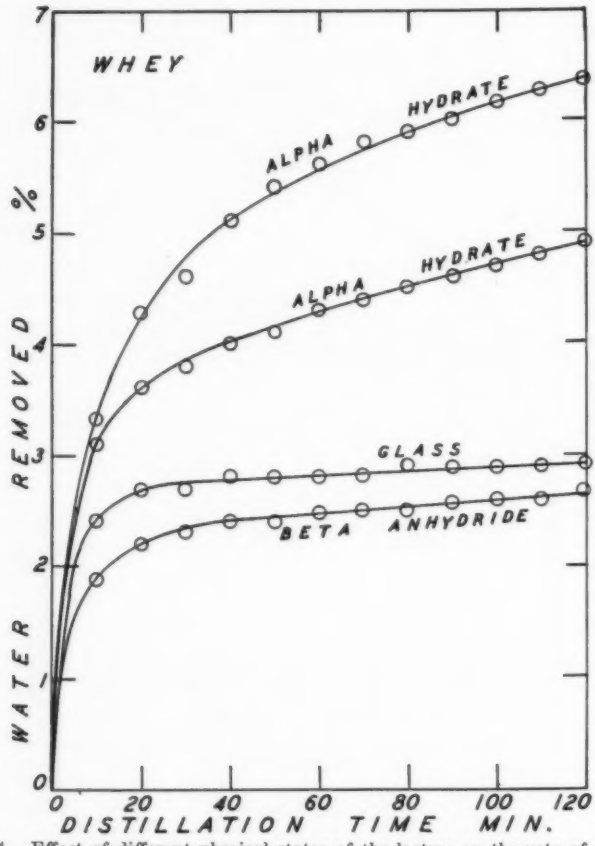

FIG. 4. Effect of different physical states of the lactose on the rate of removal of water from dried whey by the toluene distillation method.

such wheys when heated to the temperature of the boiling toluene form a sticky, doughy mass.

BEFORE AND AFTER CAKING

Troy and Sharp (12) showed that the caking of dried milks which occurs when they absorb moisture is due to the crystallization of the lactose as the α hydrate. In the ordinary spray dried or roll dried products the lactose is present in the non-crystalline state as a concentrated syrup or glass. This glass is very hygroscopic, and it will absorb moisture from atmospheres of low relative humidity. The absorbed moisture dilutes the lactose solution. The particles then become sticky, and in the case of spray dried whey plastic masses are obtained. This dilution of the syrup permits a freer movement

of the molecules and crystallization occurs, mainly as the α hydrate. This crystallization produces a hardening of the mass, which is called caking. After this process has been completed the material may be ground to a fine powder which ordinarily will not cake again and will not become sticky unless exposed to a rather high relative humidity.

Samples of spray dried whey and open roll (previously ground to reduce its bulk so that 50 gram samples could be distilled) and spray dried skimmilk were divided into aliquots and one set was placed for ten days at a relative humidity of 80 per cent. During this time the material took up water, became sticky, and caked. These samples were then held for three days at a relative humidity of 10 per cent. They were then ground, and held at a relative humidity of 20 per cent for two days. Moisture determinations were then made on the aliquots. The results are shown in Figure 5. The aliquots which had not been permitted to absorb moisture gave the relatively sharp breaks in the curves characteristic of such products. The aliquots which had

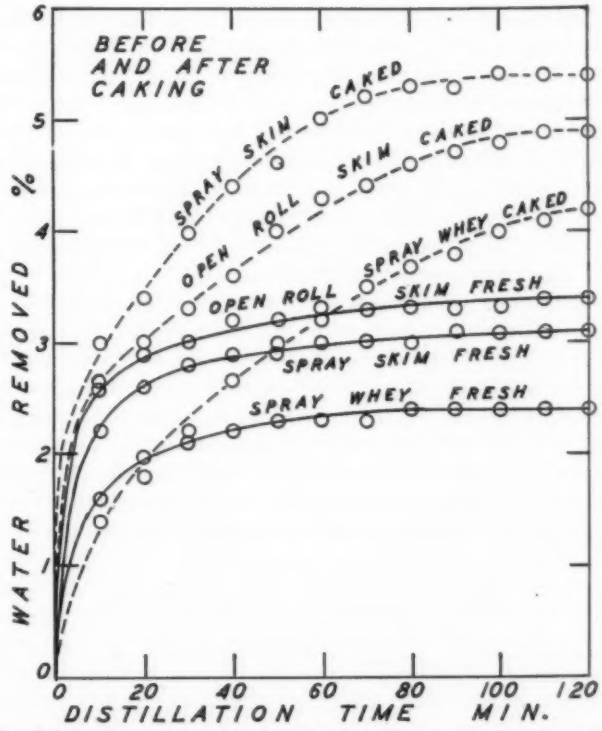

FIG. 5. Effect of previous caking on the rate of removal of moisture from dried milk and dried whey by the toluene distillation method.

gone through the caking process gave curves characteristic of products containing crystalline α lactose hydrate, and similar to those obtained with the flake or old Campbell process dried skimmilk and similar types of dried whey.

DISCUSSION

The determination of moisture in most food products is arbitrary, often to a disconcerting degree, and results which check are obtained only when the complete details of the method are adhered to rigorously. In oven drying the position of the samples in the oven, as well as the number of samples run at one time, often influences the results. Several different moisture-holding or yielding materials are present in many products and the moisture is held by several different mechanisms. In the removal of moisture by dry heating, it is often difficult to tell when a change from one moisture-holding mechanism to another occurs, and when what might be called the "true" moisture is removed without at the same time producing a change in weight of the product and the formation of water due to chemical decomposition.

The main moisture-holding materials in dried skimmilk are the proteins, principally casein, the salts, and the lactose. All of these materials have somewhat different water-holding properties. The water is apparently removed fairly readily from the casein if it is present in a fine state of division. The removal of water from the salts present in dried skimmilk probably involves no difficulty, but the salts present in dried whey, particularly whey which has previously undergone lactose fermentation or which has been highly acidified before drying, may exert a definite influence on the moisture determination. The fermentation products alter the water-holding capacity and the extent of decomposition during the heating.

The amount and physical state of the lactose exerts a marked influence upon the rate of removal of moisture. In order to make a true comparison of the different types of dried milk and dried whey on the basis of their content of milk constituents, the water of crystallization should be removed in the moisture determination from those products containing crystalline α hydrate. If the lactose is present as a glass, the methods for determination of moisture do not remove quite all of the moisture, but they reduce the moisture content of the glass to a constant, very small amount (4) (12).

Great variations in apparent moisture content resulted when samples of wheys of different characteristics were dried by heating in ovens. The degree of pressure reduction exerted a marked effect upon the results. As the pressure was reduced, the apparent moisture content increased, passed through a maximum, and then decreased again at very low pressures. These results mean that the so-called degree of vacuum under which the samples are dried has a marked effect upon the apparent moisture content, particularly of some types of whey, and makes drying by vacuum oven procedures uncertain unless the pressure in the drying oven is accurately controlled to specific,

preferably very low values. A.O.A.C. method simply says less than 4 inches (100 mm.).

The method of applying heat to the sample in the vacuum oven also influences the rate of removal of moisture. In one oven used, the sample was heated largely by radiation, in another type, by conduction. Experience indicates that the apparent moisture contents are higher in the oven in which the heat is transmitted by conduction.

Accurate moisture loss-time curves are not easily obtained by oven drying. Moisture-time curves are important because they give an indication of the properties of the material from which moisture is being removed.

The toluene distillation method was more satisfactory than oven drying for the determination of the moisture in dried whey. The equipment required is relatively simple and cheap. The method is readily adapted to control laboratory or plant use. Large samples are used. Duplicate results usually check within .1 per cent. Furthermore, distillation time curves are readily obtained which reveal the characteristics of the materials from which moisture is being removed. In adapting the toluene distillation method to the determination of moisture in dried whey, violent shaking during the distillation was found to be necessary for satisfactory results.

SUMMARY

1. Dried skimmilk and dried whey containing lactose in the crystalline α hydrate form require appreciably longer heating times for the removal of moisture than do similar products containing the lactose in the glass or crystalline β anhydride form.

2. Determination by oven drying, of the moisture content of different types of dried whey, presents considerable difficulty due to the differences in acidity, amount of fermentation products, per cent and physical state of the lactose, and method of heating and degree of vacuum in the oven.

3. The toluene distillation method possesses distinct advantages for the determination of the moisture in dried milk, dried whey, and dried casein. The moisture loss time relationship can be determined without interrupting the process or interfering with the determination. The moisture loss time relationship indicates the completeness of removal of moisture, and often indicates whether more than one mechanism is involved in the loss of moisture.

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THE EFFECT OF GELATIN ON THE CURD TENSION OF MILK

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Early in 1932 we attempted to find a method whereby a soft curd milk for use in infant feeding could easily be obtained at low cost. At that time natural soft curd milk was available in relatively few sections of the country; moreover, the expense of production placed it beyond the means of many. Our work on the modification of milk had several interruptions, but has now been resumed. While some phases of the subject require further investigation, the results thus far are, we feel, of sufficient interest to warrant publication at the present time.

No attempt will be made here to review the various methods of producing soft curd milk. Most of them possess, however, certain disadvantages. Milk which has been rendered soft curd by special processes, such as homogenization, can be obtained with difficulty or not at all by those living in isolated sections of the country. In addition, the possibility exists that soft curd milk, in which the calcium equilibrium has been altered by the zeolite treatment, may have a calcium content below the optimum for that required by those infants whose mechanism for the utilization of calcium is inefficient. The energy value of natural soft curd milk is low. Weisberg, Johnson and McCollum (11) and Hill (6) reported that natural soft curd milk contained less casein, calcium and phosphorus than hard curd milk. Berry (1) found that rats showed larger gains in body weight on a hard curd milk, which had been rendered soft curd by viscolization, than on a natural soft curd milk.

In view of these facts, it would seem highly advantageous to find a method for the preparation of soft curd milk by the addition of some easily procurable substance which would in itself add to the nutrient value of the milk. The use of cereals, such as barley flour, which have been employed in infant feeding, is prohibited in cases of infants with low carbohydrate tolerance. The fact that breast milk, which has a low curd tension, has a much higher albumin : casein ratio than does cow's milk, suggests the use of a soluble protein in the preparation of soft curd milk. In the pages that follow we will describe some of our experiments on the effect of gelatin on the curd tension of milk.

THE RELATION BETWEEN CURD TENSION AND THE CONCENTRATION OF PROTEIN IN MILK

A. *Casein*

The hardness of the curd formed in the clotting of milk must obviously bear some relation to the concentration of the casein in that curd. But, in a

Received for publication January 15, 1938.

system as complicated as milk, several other components must exist which exert more or less influence on the character of the curd. It is clear, therefore, that in order to determine the exact relationship of the curd tension to the concentration of the casein, both the nature of these other components as well as the extent of their influence must be known. Even though an attempt is made to maintain a fairly constant concentration of these components in the milk, the results will at best give one but a rough idea as to the extent of the dependence of curd tension on casein concentration.

The casein content of several samples of raw whole milk[1] was determined by the official method (8). The milks were all obtained from Guernsey or Jersey cows, except in a few cases of soft curd milk, where a pooled sample was used. The sealed bottles containing the milk were packed in ice and sent from the dairy farms in New Jersey or New York State to our laboratory in New York City. The curd tension of these same milks was determined by the method of Hill (5). The concentration of pepsin was constant in all the experiments in which curd tension was determined; the addition of the large quantity of calcium chloride in the coagulation probably resulted in a fairly constant concentration of calcium ions, while the high buffer capacity of the system helped to keep the concentration of hydrogen ions within rather narrow limits. Our results, as well as those of Morris and Richardson (7), of Weisberg, Johnson and McCollum (11), and of Doan and Welch (3) are

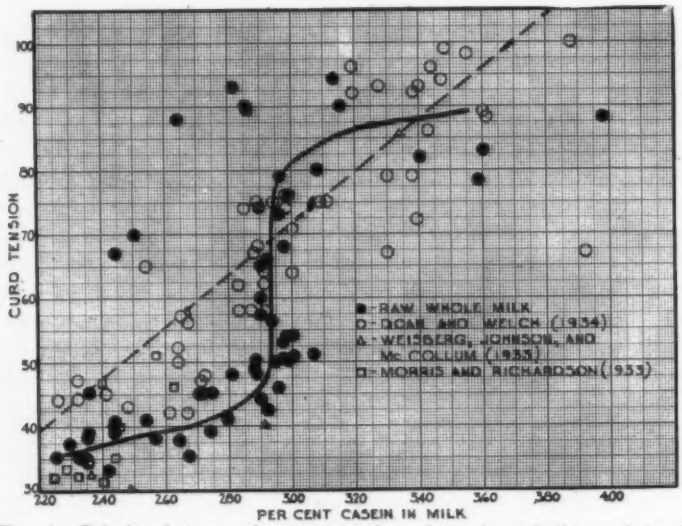

FIG. 1. Relation between the concentration of casein and the curd tension of milk.

[1] We wish to thank the Sheffield Farms Company for supplying the milk used in part of this research.

shown in Figure 1. Most of the results of Espe and Dye (4) fell outside the limits of curd tension in the figure. The variation in the curd tension of different milks with approximately the same concentration of casein shows clearly the influence of other factors in the coagulating system. A large number of our points, however, appear to describe an S-shaped type of curve. The straight line was drawn from the Doan and Welch equation (3), which relates curd tension to casein concentration. Our values seem to follow the S-shaped curve rather better than the straight line.

In most of the milk samples thus far investigated a high curd tension is accompanied by a high casein concentration, and a low curd tension is found in milks with a low casein concentration. However, wide variations in curd tension occur in milks with the same concentration of casein. Further investigation is necessary before the exact relation between curd tension and casein concentration can be ascertained.

B. *Gelatin*

It has just been shown that in a large number of cases the curd tension of milk increases with increasing concentration of casein. The effect of a soluble protein, gelatin, on the curd tension of milk will now be described.

The gelatin used in this work, unless otherwise noted, was a sample of Knox Gelatine.[2] The milk samples were the same as those described in the preceding section. The gelatin was weighed into the regular test jar, 100 cc. of milk at room temperature was introduced, and the mixture was allowed to stand for a few minutes until the gelatin was thoroughly soaked. The jar was then placed in a water bath at 60° C. and the contents were stirred until the gelatin was dissolved. The mixture was then allowed to stand at room temperature with occasional stirring until the temperature reached 35° C., when the curd tension was determined by the method of Hill. Milk, which contained no gelatin but which was subjected to the same conditions of heating, exhibited the same curd tension as the unheated milk. The results are given in Figure 2.

Each of the curves represents the average values obtained over a range of about 10 grams of curd tension; thus, the curve which begins at a curd tension of 45 grams is the average of all the results for milks with an initial curd tension between 41 and 50 grams. The curves illustrate in striking fashion the lowering of the curd tension of milk by gelatin. If a curd tension of 33 grams or lower is taken to represent a soft curd milk, then, in general, milks with an initial curd tension up to about 50 grams are converted into soft curd milks by the addition of two per cent of gelatin, while those with an initial curd tension up to about 70 grams are rendered soft curd by the addition of four per cent of gelatin. Most of the samples of

[2] Bone gelatin: pH 6.1, viscosity 61, jelly strength 200.

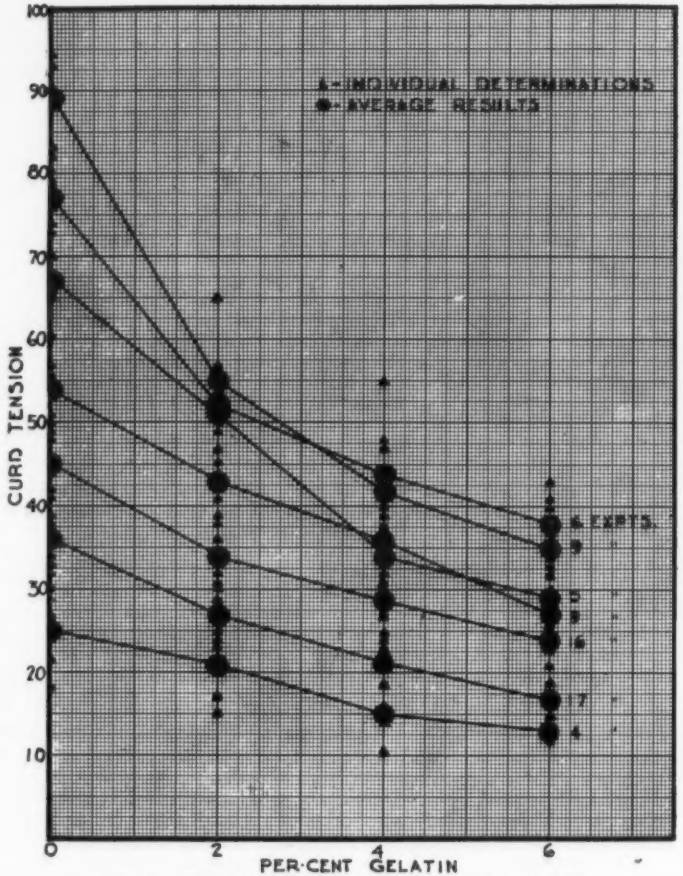

FIG. 2. Effect of gelatin on the curd tension of milk.

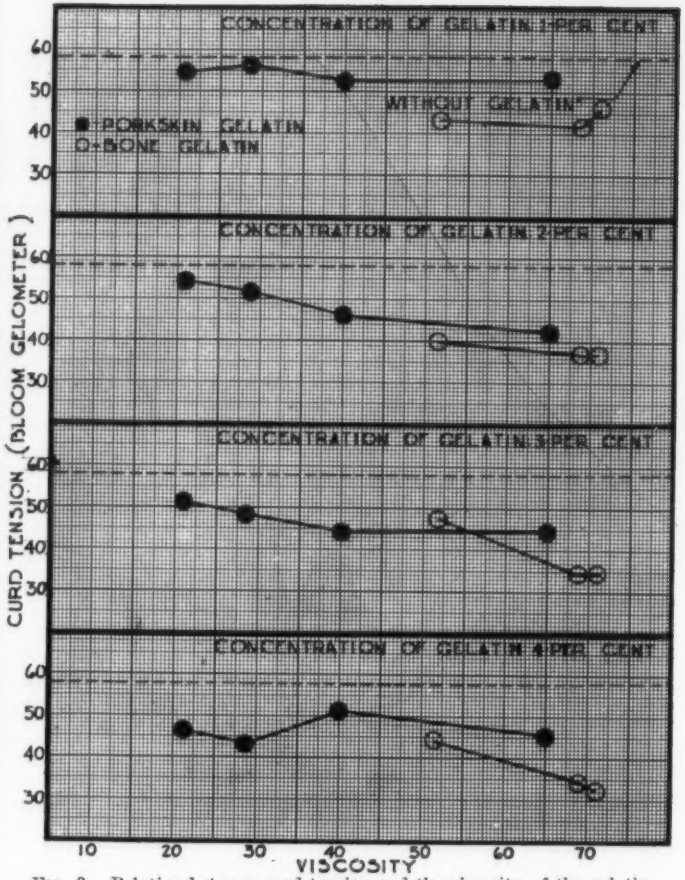

FIG. 3. Relation between curd tension and the viscosity of the gelatin.

milk, which we have purchased in the open market in New York City and elsewhere have had curd tensions below 50 grams.

The percentage reduction in curd tension by different concentrations of gelatin is shown below in Table 1.

TABLE 1

Percentage reduction in the curd tension of milk by gelatin

Range of initial curd tension	Average percentage reduction in the curd tension of milk by gelatin of the following concentrations		
Grams	2 per cent	4 per cent	6 per cent
18–30	14	37	44
31–40	27	41	54
41–50	25	35	47
51–60	21	34	49
61–70	24	49	57
71–80	32	42	50
81–94	38	53	60

In general, the percentage reduction in the curd tension of milk by two per cent of gelatin is greater for a hard curd than for a soft curd milk. The addition of the first two per cent of gelatin to the milk brings about a greater percentage reduction than do subsequent additions of two per cent of gelatin. The addition of six per cent of gelatin to milk reduces the curd tension to about one-half of its original value.

The above experiments show clearly that gelatin is very effective in reducing the curd tension of milk. But when these experiments were repeated with a sample of bulk gelatin from the hospital kitchen the reduction in the curd tension of milk was much smaller. In the literature the statement is occasionally found that gelatin has no effect on the curd tension of milk. This would indicate that all gelatins are not equally effective in reducing the curd tension of milk.

Riggs and Beaty (9) at a meeting of the American Chemical Society in New York City in 1935 reported that the lowering of the curd tension of milk by gelatin was related to the viscosity of the gelatin sample employed; *i.e.*, the higher the viscosity of the gelatin the greater the reduction in curd tension.

We have been extremely fortunate in having placed at our disposal seven different preparations of gelatin,* some properties of which are listed in Table 2.

The viscosity and jelly strength of these gelatin preparations were determined by the regular methods (10). The pH of a one per cent solution of the gelatin in water was estimated with the glass electrode.

Striking differences are noted in the properties of the porkskin and of

* We are indebted to Dr. Thomas B. Downey for the data on the viscosity and jelly strength of the various gelatins used throughout this investigation.

TABLE 2

The properties of some gelatin preparations used in experiments on curd tension of milk

Number of gelatin preparation	Source of gelatin	Viscosity	Jelly strength	pH
		millipoise		
P–1	Porkskin	65.0	305	3.82
P–2	"	40.2	225	4.05
P–3	"	28.7	139	4.20
P–4	"	21.4	84	4.32
B–1	Bone	51.6	246	6.08
B–2	"	68.7	197	6.14
B–3	"	71.0	166	5.90

the bone gelatin preparations. The porkskin gelatins show a much higher acidity than do the bone gelatins. In the case of porkskin gelatins, viscosity increases with increase in jelly strength, while for the bone gelatins, viscosity increases as the jelly strength decreases.

A study has been made of the effect of these gelatins on the curd tension of milk. A few changes have been introduced in the experimental procedure. The milk samples were obtained from Guernsey cows from a dairy farm about thirty miles from the laboratory. The samples were obtained at the afternoon milking and were kept at a low temperature until used the following morning. The milk was then brought to 25° C., 100 cc. were pipetted into the test bottles, which contained the weighed amount of gelatin, and the mixture was allowed to stand at room temperature for fifteen minutes. The test bottles were closed with a rubber stopper which was provided with a thermometer and a small outlet to allow for the expansion of air during heating. The jars were then transferred to a thermostat maintained at 40° C. and the contents were swirled around two or three times at five minute intervals. At the end of one-half hour the bottles were removed from the thermostat and allowed to stand, with occasional stirring, at room temperature until the temperature of the contents had dropped to 35° C. The curd tension was then determined either with the Hill apparatus or with the modified Bloom gelometer (2).

The results of two of a series of experiments are given in Figures 3–6. The curd tensions shown in Figures 3 and 5 were obtained with the modified Bloom gelometer for varying concentrations of the gelatins in milk, the original curd tension of which was 58 grams. Those given in Figures 4 and 6 were obtained in a similar experiment using the Hill apparatus and a different sample of milk, which also had an initial curd tension of 58 grams. Because of the differences in pH of the gelatin samples (to be discussed in detail below) the curves for the bone gelatin preparations and for the porkskin gelatin preparations have been drawn separately. The results show that within the limit of experimental error the reduction in curd tension

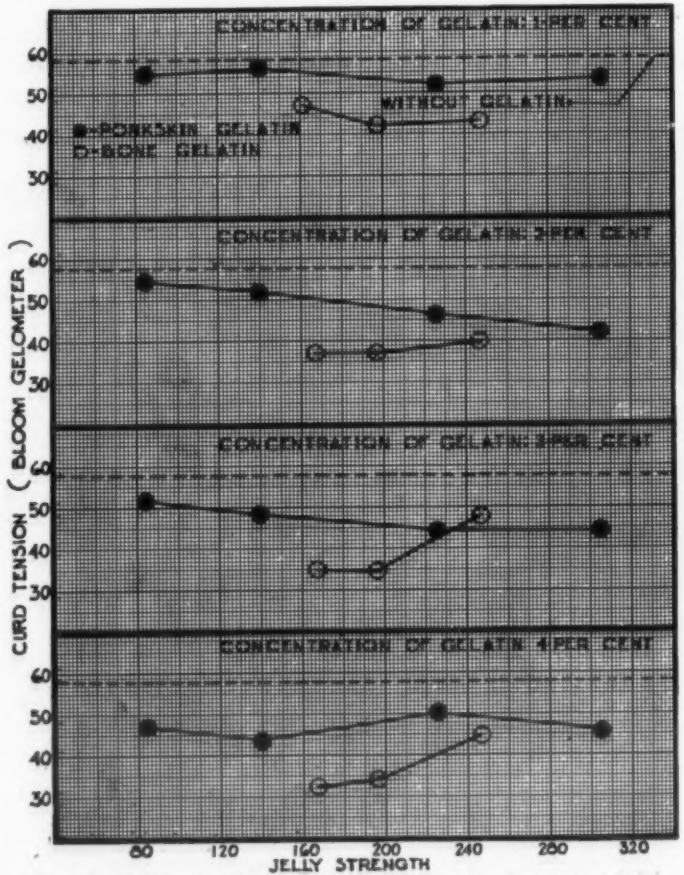

FIG. 4. Relation between curd tension and the viscosity of the gelatin.

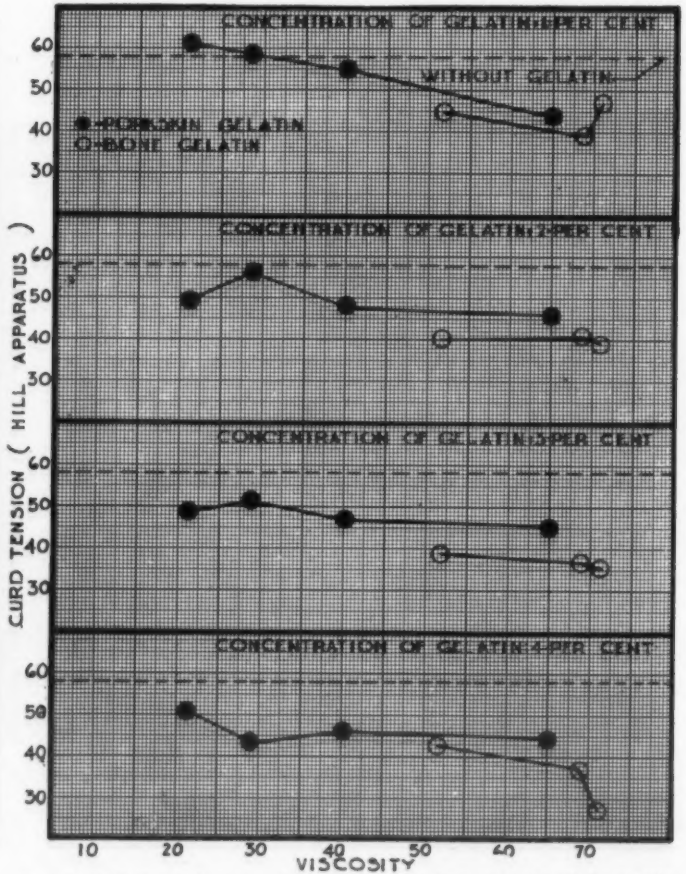

FIG. 5. Relation between curd tension and the jelly strength of the gelatin.

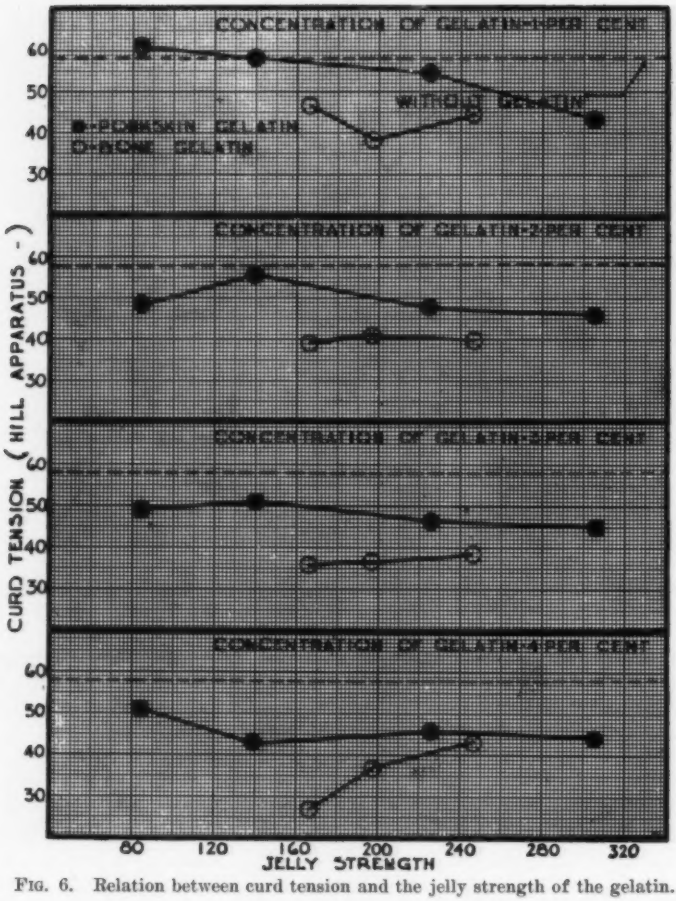

FIG. 6. Relation between curd tension and the jelly strength of the gelatin.

increases with increase in the viscosity of the gelatin preparation employed. If the reduction in curd tension is compared with the jelly strength of the gelatins, however, the two types of gelatin show a different behavior. With increase in jelly strength the reduction in curd tension increases in the case of the porkskin gelatins and decreases in the case of the bone gelatins. The most effective gelatin from the standpoint of reduction of curd tension was a bone gelatin with a high viscosity and a low jelly strength; the least effective, a porkskin gelatin with a low viscosity and a low jelly strength.

The percentage reduction in the curd tension of milk by the bone and by the porkskin gelatins is given in Table 3. The results are the average of six experiments on milks with initial curd tensions between 34 and 58 grams.

TABLE 3

Percentage reduction in the curd tension of milk by various types of gelatin

Gelatin number	Viscosity of gelatin	Average percentage reduction in the curd tension of milk by gelatins of the following concentrations			
		1 per cent	2 per cent	3 per cent	4 per cent
	millipoise				
P–4	21.4	6	14	17	21
P–3	28.7	5	12	21	28
P–2	40.2	10	18	29	25
P–1	65.0	17	22	28	24
B–1	51.6	21	33	31	30
B–2	68.7	30	37	44	41
B–3	71.0	24	39	44	48

In nearly every case an increase in the reduction of the curd tension follows an increase in the viscosity of the gelatin sample from the same source. However, if the gelatin samples are considered, irrespective of source, the P–1 gelatin is seen to occupy an anomalous position; *i.e.*, the reduction in curd tension is less than would be predicted from its viscosity. The extremely high jelly strength of the P–1 gelatin may explain this behavior, in part, at least; incipient gel formation during coagulation of the milk would tend to raise the curd tension reading and so lead to erroneous conclusions regarding the reduction in curd hardness. This effect would be greater the higher the concentration of gelatin in the milk.

These experiments explain why investigators working with one per cent solutions of gelatins similar in properties to P–3 or P–4 would fail to obtain a marked lowering of the curd tension of milk.

THE RELATION BETWEEN CURD TENSION AND THE CONCENTRATION OF HYDROGEN IONS IN MILK

In the early part of our investigation we studied the effect of the pH on the curd tension of milk alone and of milk to which had been added five per cent of gelatin (Knox Gelatine). Pasteurized milk was used in this work. A measured amount of 0.1400 N hydrochloric acid or of 0.1094 N sodium hydroxide was added in a fine stream from a burette to 100 cc. of milk. The mixture was rotated constantly during the addition to prevent any local excess of reagent. In the case of milk containing gelatin, the gelatin was first dissolved in the milk before the addition of the acid or the alkali. The pH was determined with the quinhydrone electrode. The curd tension was estimated by means of the Hill apparatus. The results are given in Figure 7.

The initial curd tensions of the milks varied from 17 to 43 grams. The curves represent approximately the average curd tensions of the milks at the various pH values. Nine complete titrations were performed on milk alone and six on milk with added gelatin. The pH was found to have a very marked effect on the curd tension. In the case of milk alone the average

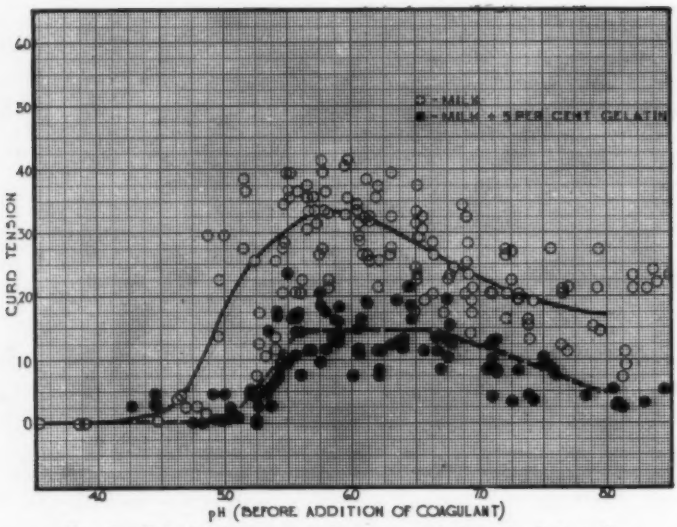

FIG. 7. Relation between curd tension and the pH of the milk.

curd tension curve reached a maximum at a pH of about 5.7 to 5.9. Beyond this point the decrease in curd tension with increasing acidity was probably due to the removal of the casein from colloidal solution by precoagulation with acid, which left less and less of the protein to react with the pepsin. The fall in curd tension on the alkaline side of the maximum was due, in part at least, to the inactivation of pepsin by the alkali. The average curd tension curve for the milk which contained five per cent of gelatin is striking in that here we do not have a maximum point, but rather a maximum zone which extends from approximately pH 5.6 to 6.6. Since the pH was determined with the quinhydrone electrode, no attempt was made to extend the curves beyond pH 8.

The addition of five per cent of the gelatin to the milk changed the pH on an average from 6.57 to 6.35. Such a pH change would in itself result in only a very slight increase in curd tension.

As has already been noted, a marked difference in acidity existed between the bone gelatin preparations and the porkskin gelatin preparations used in the present investigation. The effect of these gelatin preparations on the pH of the milk is shown below in Table 4. The pH values recorded here were estimated by means of the glass electrode.

Addition of two per cent of the various gelatins increased the acidity of the milk, the porkskin gelatins having a somewhat greater effect. After coagulation, however, the pH of the coagulated milk which contained two per cent of bone gelatin was the same as that of the coagulated milk to which

TABLE 4

The effect of various gelatins on the pH of milk

Gelatin number	pH of original gelatin preparation	pH of a 2 per cent solution of gelatin in milk	
		Before addition of coagulant	After addition of coagulant
P–1	3.82	6.06	5.39
P–2	4.05	6.04	5.42
P–3	4.20	6.08	5.47
P–4	4.32	6.13	5.45
B–1	6.08	6.28	5.60
B–2	6.14	6.29	5.60
B–3	5.90	6.29	5.57
pH of original milk, before coagulation: 6.47 after coagulation: 5.60			

no gelatin had been added, while the pH of the milk which contained the porkskin gelatin was slightly more acid. It is doubtful whether this change in acidity is large enough to cause any marked difference in curd tension; yet since slight differences do exist, it seems advisable at the present time to consider the two types of gelatin separately.

SUMMARY

In general, increase in the curd tension of milk was accompanied by an increase in casein concentration, although wide variations occurred. The relation of the curd tension to the concentration of the casein seemed to follow approximately an S-shaped curve.

The addition of gelatin (Knox) to milk caused a marked fall in curd tension. In most cases, two per cent of gelatin added to milks of curd tension up to about 50 grams converted them to soft curd milks.

The reduction in the curd tension of milk increased with increasing viscosity of the gelatin preparation employed. As the jelly strength of the gelatin preparation increased, the reduction in curd tension increased for the porkskin gelatins and decreased for the bone gelatins.

A bone gelatin with a high viscosity and a low jelly strength was most effective in lowering the curd tension of milk.

The pH was found to have considerable influence on the curd tension. The average curd tension of milk reached a maximum when the pH of the milk before coagulation was between 5.7 and 5.9. In the case of milk which contained five per cent of gelatin, the average maximum curd tension occurred when the pH before coagulation was between 5.6 and 6.6.

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THE LIPASE, FATTY ACID AND CHOLESTEROL CONTENT OF COW'S BLOOD IN RELATION TO THE PRODUCTION OF RANCID MILK

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In a study of off-flavored milk (4) (5) (6), significant differences were found between the composition of normal and that of rancid milk produced by animals of the same breed while maintained under the same nutritional and environmental conditions. Rancid samples were lower in lactose and higher in chloride, fat, total solids, protein, titratable acidity and hydrogen-ion concentration than were normal samples obtained during same period of lactation. Of perhaps even greater significance, the lipolytic activity of rancid milk was found to be greater than that of normal milk.

The increased lipase content of rancid milk has come to be regarded as one of the causes, if not the sole cause of natural rancidity. The flavor of rancid milk is attributed to the presence of free fatty acids, an unusual amount of which is thought to be released as a result of the increased amount of lipase. It has been suggested, however, that other factors may contribute to the production of rancidity. There is the possibility of the presence in milk of some substance which acts either as an activator or an inhibitor of lipase activity and which may be present in larger or smaller amounts in rancid milk than in normal milk. Cholesterol suggests itself in this role; it is a normal constituent of milk and has been shown to exert an effect upon lipase activity. The exact nature of its influence, however, appears to be a matter of disagreement. Remezov and Tavaststyerna (7) consider cholesterol an important regulator of serum lipase activity. They found that *in vivo*, cholesterol inhibits blood lipase by adsorption. Later, however, Corran (2) reported that cholesterol in low concentration acts as an augmenter of lipolysis.

Inasmuch as blood is the ultimate source of milk constituents, it appeared possible that the blood of animals producing rancid milk might differ in certain respects from that of animals whose milk is normal. The increased lipase of rancid milk might be due to increased blood lipase; the free fatty acid giving rancid milk its flavor might be the result of elevated blood fatty acids; an unusual amount of blood cholesterol might bring about an unbalance between the cholesterol and lipase of milk, resulting in an abnormal lipolytic activity, with the consequent production of rancid milk. Determinations were therefore made of the lipase, fatty acid and cholesterol content of the

Received for publication February 2, 1938.

blood of certain members of the herd under observation in a study of off-flavored milk. The present paper reports the results of these determinations.

EXPERIMENTAL

The cows used in the experiment were members of the college Jersey herd. The care and management of the herd have been described in detail in a previous paper (4). Milk samples obtained weekly from each member of the herd over a period of three years were scored for flavor and analyzed. Certain of these cows were selected as subjects of the blood study which was continued over a period of nine months. Blood samples were always taken early in the morning, approximately three hours after the cows were fed. The number of samples obtained from the individual animals varied, depending upon the length of time the animal was available for the experiment. In five cases practically complete lactations were covered.

Blood was drawn from the jugular vein into a centrifuge tube and the serum obtained by centrifugation after the clot had formed. The total lipids were determined by the oxidation method of Bloor (1). The fatty acids were calculated by difference after the determination of the cholesterol by the Liebermann-Burchard reaction, following Bloor's procedure. The lipolytic activity of the blood was determined by a procedure which was essentially the same as that employed by McGuire and Falk (3). This method determines the degree of hydrolysis of tributyrin effected by 15 ml. of a 1 : 1 dilution of serum during a 24-hour incubation period. The lipolytic activity of the serum is expressed as ml. of 0.1 N NaOH required to neutralize the acid released by hydrolysis.

The method used for estimating lipase activity was capable of detecting the presence of 0.5 cc. serum, as may be seen in Table 1 which shows the degree of hydrolysis produced by increasing amounts of serum.

TABLE 1

Degree of hydrolysis of tributyrin effected by increasing amounts of serum

Ml. serum	Degree of hydrolysis ml. 0.1 N NaOH
0.5	0.6
1.0	1.0
5.0	3.3
7.5	4.6

The lipolytic activity of 112 blood samples was determined. Of these, 44 samples were taken on days when the animals produced rancid milk. The blood of animals producing rancid milk was found to effect the same degree of hydrolysis as did that of animals whose milk was normal. The mean titration for the former group was 4.48 ml., that of the latter, 4.41 ml. The

increased lipolytic activity of rancid milk may not, therefore, be explained on the basis of an increased lipase content of the blood.

Since few data are available on the fatty acid and cholesterol content of

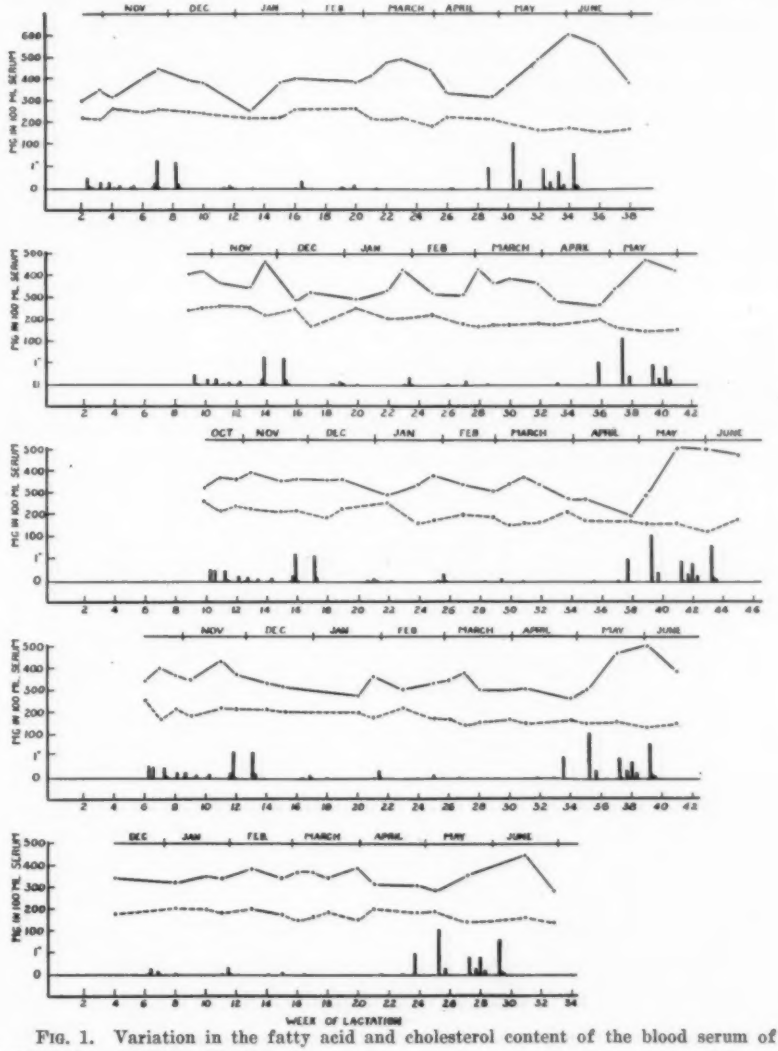

FIG. 1. Variation in the fatty acid and cholesterol content of the blood serum of individual cows during lactation.

——— Fatty acid.
- - - - - - Cholesterol.
■ Rainfall.

TABLE 2

Influence of green pasture on the fatty acid and cholesterol content of the blood serum of cows

Animal number	Condition of pasture	Week of lactation	Fatty acids	Cholesterol	Animal number	Condition of pasture	Week of lactation	Fatty acids	Cholesterol
			mg. per 100 ml. serum	*mg. per 100 ml. serum*				*mg. per 100 ml. serum*	*mg. per 100 ml. serum*
1	D[1]	27	349	137	6	D	22	325	221
	G[2]	31	445	159		G	24	503	185
2	D	22	242	153	7	D	35	301	147
	G	26	388	112		G	39	506	131
3	D	17	259	138	8	D	17	315	242
	G	19	454	114		G	20	519	163
4	D	39	289	158	9	D	21	304	205
	G	41	498	171		G	24	507	144
5	D	32	498	171	10	D	22	299	213
	G	34	609	177		G	25	499	177

[1] Dry pasture.

[2] Green pasture.

the blood of lactating cows, individual curves for approximately complete lactations are shown for five cows in Figure 1. Two of these animals, numbers 4 and 5, frequently produced rancid milk. From the graphs it is evident that the trend of the cholesterol content of the blood paralleled that of the fatty acids but that changes in the fatty acids were the more pronounced. These constituents tended to increase during the first months of lactation then to decrease gradually as lactation advanced. The most marked variation occurred in the months of May and June when the fatty acids showed a pronounced increase without a corresponding change in the cholesterol. This marked rise in fatty acids was attributed to the improvement in the pasture, since, as may be seen in Figure 1, it occurred immediately after a period of rainfall which broke a long period of drought. All cows showed the rise in fatty acids, regardless of the period of lactation. This is shown in Table 2 which gives the stage of lactation and the fatty acid and cholesterol content of blood while the pasture was dry and after it became green.

Monthly variations in the fatty acids and cholesterol of the blood are shown in Figure 2. The graphs in this figure present mean values for all animals under observation. Values have not been included for those periods when the fatty acid content was increased because of green pasture. The

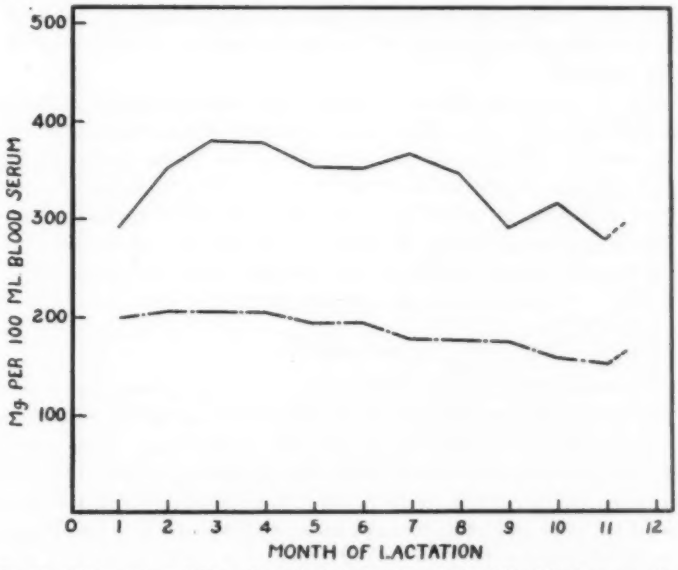

FIG. 2. The average fatty acid and cholesterol content of the blood serum of cows in relation to the period of lactation.

——————— Fatty acid.
——·——·—— Cholesterol.

fatty acid of blood was marked by a sharp rise during the first 12 weeks of lactation, a gradual decline during the succeeding 20 weeks, followed by a sharp decline which lasted until the end of lactation. The cholesterol content remained nearly constant for the first 24 weeks, then decreased gradually to the end of the lactation period.

A total of 248 blood samples were analyzed. In Table 3 are shown the mean fatty acid and cholesterol content of all samples taken on days when the milk was normal and the mean values for samples taken on days when rancid milk was produced.

TABLE 3

Mean fatty acid and cholesterol content of blood serum of cows producing normal and rancid milk

Source of samples	Blood samples	Fatty acids	Cholesterol
	number	*mgs. per 100 ml. serum*	*mgs. per 100 ml. serum*
Cows producing normal milk	212	368.3	189.7
Cows producing rancid milk	36	359.7	213.7

It is evident from the table that there was no significant change in the fatty acid and cholesterol content of the blood of animals on days when rancid milk was produced.

During the period of the blood study seven cows produced rancid milk. Two of these animals had a blood fatty acid and cholesterol content higher than the average value for the same periods of lactation; the levels for the other five animals closely followed the normal. The mean fatty acid and cholesterol content of all samples of blood from the seven animals which produced rancid milk was 368 mg. and 192 mg. per 100 ml. serum, respectively, as compared with values of 388 mg. and 202 mg. for animals producing only normal milk. The differences are not significant.

CONCLUSIONS

Normal values for the fatty acid content of the blood serum of cows show a sharp increase during the first three months of lactation, followed by a gradual decrease which continues to the end of lactation. The cholesterol content of the blood shows a similar but less pronounced rise followed by a slight decline. A marked increase in blood fatty acids occurs when lactating cows are changed from dry to green pasture. This increase occurs regardless of the stage of lactation.

The fatty acid and cholesterol content of the blood serum of cows producing rancid milk follows the same trend as does that of cows producing normal milk during corresponding periods of lactation. There is no increased lipo-

lytic activity in the blood serum of cows producing rancid milk, although such milk has a greater lipase content than normal milk.

The production of rancid milk cannot be explained on the basis of a change in any one of the above blood constituents.

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COFFEE AS A FACTOR IN THE FEATHERING OF CREAM

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The feathering of cream when mixed with hot coffee was first reported upon by Burgwald (1) in 1923. He found acidity of the cream and homogenization to be the most important factors causing this defect. The method of preparing the coffee, according to Burgwald, was not important as the hydrogen ion concentrations of the brew made by boiling, percolating and by the drip method were practically identical (4.91–4.92). Burgwald further stated that there was no difference in the effect of the various grades of coffee upon feathering. The method of combining the coffee and cream was of no great consequence although the cream feathered at a slightly lower acidity when the coffee was added to the cream and sugar mixture.

In 1930 Tracy and Ruehe (2) showed that the feathering of homogenized cream in coffee was closely related to the salt balance in the cream and coffee mixture. An excess of calcium or magnesium salts in either the cream or water used for making the coffee increased the tendency for the cream to feather. Cream high in acidity and that high in butter fat were found to be rather unstable. Lowering the fat content, reducing the acidity, increasing the serum solids, the addition of citrate salt, preheating and homogenizing at a high temperature, reducing the homogenizing pressure, and the use of two homogenizing valves instead of one, were factors found to reduce the tendency towards feathering through their effect in reducing fat clumping.

The work of Doan (3) substantiated the findings of Tracy and Ruehe. Whitaker (4) in studying the feathering of evaporated milk in coffee found that the milk was more likely to feather in strong than in weak coffee. Furthermore he found that the hydrogen ion concentration of the coffee remained constant and was independent of the method of preparation. Prolonged contact of the coffee and grounds, however, were shown to increase the quantity of soluble ash and consequently tended to increase feathering.

PLAN OF STUDY

In order to obtain a better understanding as to what part coffee may play in the problem of cream feathering, samples of coffee were secured from a number of different processors and distributors. Altogether samples of twenty-six brands were obtained for this purpose. These coffees were compared from the standpoint of:—

1. Relative tendencies towards feathering.
2. Comparison of different methods of making coffee in relation to feathering.

Received for publication March 4, 1938.

3. Significance of amount of coffee used.
4. Relation of coffee species, degree of roast and method of curing to feathering.
5. Extent to which age of the coffee affects its tendency to feather.
6. Procedure followed in mixing coffee and cream.

METHOD OF PROCEDURE

The degree of feathering was determined in coffee brew made from different water selected from the following group:

Water sample No.	Water used	Ave. pH
1	Tap	7.2
2	Distilled plus Mg. (16 ppm.) and Ca (30 ppm.)	6.95
3	Distilled plus Mg. (20 ppm.) and Ca (60 ppm.)	6.75
4	Distilled plus Mg. (30 ppm.) and Ca (80 ppm.)	6.70
5	Distilled plus Mg. (40 ppm.) and Ca (120 ppm.)	6.90

The coffee was measured with a measuring tablespoon and unless otherwise stated was used at the rate of one level tablespoon per measuring cup of water.

The regular procedure for making the coffee by the percolator method was to heat the coffee for five minutes after it began percolating. When made by the drip method the water was poured over the coffee in a regular coffee dripolator. When the coffee was boiled the percolating pot with the percolator removed was used.

The amount of feathering was determined using coffee brews at four different temperatures (120°, 145°, 170°, and 195° F.). One hundred ml. of coffee brew was poured into a 100 ml. glass graduate. When the temperature was properly adjusted 10 ml. of fresh 22% cream homogenized at 700 pounds pressure and at a temperature of 140° F. was added. The contents were mixed by pouring into a beaker and back into the graduate. The coagulum that rose to the top was then measured in terms of ml.

All pH measurements were made on the cold coffee brew, using a Coleman portable type apparatus with glass electrode.

The coffees were scored on the basis of the amount of coagulum formed during the feathering test. Although this method is to be criticized because of possible slight variations in the packing of the coagulum in the top of the graduate, the method is rapid and was thought to be sufficiently accurate to give relative values. Since the coffees made with water of varying calcium and magnesium content represented different degrees of severeness of the

test it was necessary to assign arbitrary values to these different coffees in order to arrive at a total score for each coffee made with the four different waters. The assumed values for each cubic centimeter of coagulum formed were as follows:

Temperature	Score value				
	Water 1	Water 2	Water 3	Water 4	Water 5
120° F.	*	*	*	*	*
145° F.	*	*	*	6	4
170° F.	*	*	5	3.5	2
195° F.	*	5	3	2	1

* No value was assigned as feathering did not occur when using this water at the indicated temperature.

RELATIVE FEATHERING TENDENCIES OF COFFEES OF DIFFERENT BRANDS

To compare the relative feathering tendencies of coffees, samples of 26 different brands were used. The coffee brews were made by the percolator method. The results are given in Table 1.

Examination of the data in Table 1 will show some of the coffee brews to differ in their feathering tendencies. It was only when a water containing magnesium and calcium, added to the extent of 40 and 60 parts per million respectively, was used, that the brand of coffee became a factor. It may be concluded, therefore, that it would be only when unfavorable conditions existed that this tendency on the part of certain coffee to be a factor, would be of any significance. For example, when the cream was of high quality, contained a normal salt balance, and was not processed in such a way as to produce excessive fat clumping, and when the water used to make the coffee was not high in calcium or magnesium content, tendencies for certain brands of coffee to favor feathering more than other brands would be of no particular importance. However, there may be cases where the cream is so nearly destabilized when mixed with the hot coffee that the particular ingredient in the coffee responsible for the feathering may be just the factor necessary to bring about the coagulation. This condition may account for slight variations in results obtained by different dispensers of coffee brew that are being served by the same dairy.

Just what the coffee constituent is that favors cream feathering is not known. Whitaker (4) suggests the ash content of the bean as important in this respect. Acetic, formic and valeric acids have been reported by various investigators (5) of the composition of the volatile oils of coffee suggesting coffee acidity as a possible factor in feathering. While no exact correlation seems to exist between pH of the brew and feathering there are some general tendencies in this respect as shown by the data in Table 2. The lack of a clear cut correlation between the pH of the brew and feathering would indicate the presence of more than one constituent in the coffee that is related to the heat coagulation of the cream protein.

TABLE 1

Comparison of different coffees in their tendencies to produce feathering

Brand No.	pH	Brew 1 ml curd formed			pH	Brew 2 ml curd formed			pH	Brew 3 ml curd formed			pH	Brew 5 ml curd formed			Score*
		145°	170°	195°		145°	170°	195°		145°	170°	195°		145°	170°	195°	
1	6.35	0	0	0	4.90	0	0	0	4.80	0	0	12	4.70	1.5	13.5	17	86
2	6.70	0	0	0	4.82	0	0	0	4.90	0	0	0	4.78	0	0	15	15
3	6.45	0	0	0	4.92	0	0	0	4.91	0	0	0	4.80	0	11	13.5	35.5
4	6.68	0	0	0	4.75	0	0	6	4.67	0	0	10.5	4.58	7.5	14	16	135.5
5	6.87	0	0	0	4.70	0	0	0	4.65	0	0	8	4.51	9	12.5	13.5	98.5
6	7.18	0	0	0	4.70	0	0	0	4.70	0	0	1	4.63	0	7	12	29
7	6.80	0	0	0	5.05	0	0	0	4.95	0	0	0.5	4.90	0	0	14	15.5
8	7.15	0	0	0	4.95	0	0	0	4.90	0	0	9	4.88	0	6	16	55
9	6.90	0	0	0	5.00	0	0	0	4.98	0	0	0	4.82	0	7	13.5	27.5
10	6.95	0	0	0	5.08	0	0	0	5.02	0	0	0	4.92	0	5	11.5	21.5
11	7.05	0	0	0	5.01	0	0	0	5.00	0	0	0	4.95	0	9.5	10	29
12	7.60	0	0	0	5.20	0	0	0	5.19	0	0	0	5.05	0	0	10	10
13	7.35	0	0	0	5.02	0	0	0	5.02	0	0	4	4.88	4	10	15	63
14	7.68	0	0	0	5.09	0	0	0	5.08	0	0	10	4.99	0	7	15	59
15	7.42	0	0	0	5.29	0	0	0	5.23	0	0	0	5.15	0	0	11	11
16	7.39	0	0	0	5.46	0	0	0	5.37	0	0	0	5.26	0	0	4	4
17	7.27	0	0	0	5.10	0	0	0	4.90	0	0	1	4.91	0	4	13	24
18	6.68	0	0	0	5.09	0	0	0	5.06	0	0	2	4.88	0	12	13	23
19	7.02	0	0	0	5.17	0	0	0	5.08	0	0	0	5.02	0	13	12	18
20	7.30	0	0	0	5.12	0	0	0	5.07	0	0	0	4.97	0	18	12	28
21	7.24	0	0	0	5.02	0	0	0	4.93	0	0	3	4.82	2	12	17	58
22	7.01	0	0	0	5.24	0	0	0	5.26	0	0	2	5.10	0	1	12	20
23	7.05	0	0	0	5.20	0	0	0	5.10	0	0	1	5.02	1	7.5	12.5	34.5
24	7.02	0	0	0	5.16	0	0	0	5.18	0	0	5	5.03	0	9	12	45
25	6.37	0	0	0	4.82	0	0	1	4.80	0	6	8	4.70	5	11	13	114
26	6.65	0	0	0	5.16	0	0	0	5.10	0	0	0	.....	0	11	.....	.....

* The higher the score the greater the degree of feathering.

TABLE 2

Relation of pH of coffee brew to cream feathering

Coffee No.	pH* Score**	
	Group 1	
16	5.36 – 4	
12	5.15 – 10	
15	5.22 – 11	
2	4.83 – 15	
7	4.97 – 15.5	Score 0–24
19	5.09 – 18	Ave. pH 5.08
10	5.01 – 21.5	
22	5.20 – 22	
18	5.01 – 23	
17	4.97 – 24	
	Group 2	
9	4.93 – 27.5	
20	5.05 – 28	
6	4.68 – 29	
11	4.99 – 29	Score 25–49
23	5.14 – 34.5	Ave. pH 4.97
3	4.88 – 35.5	
24	5.12 – 45	
	Group 3	
8	4.91 – 55	
21	4.92 – 58	Score 50–74
14	5.05 – 59	Ave. pH 4.96
13	4.97 – 63	
	Group 4	
1	4.80 – 86	
5	4.62 – 98.5	Score 75–150
25	4.77 – 114	Ave. pH 4.71
4	4.67 – 135.5	

* Based on average of brews 2, 3 and 5.
** Represents total score for groups 2, 3 and 5.

ORIGIN OF COFFEE AND METHOD OF ROASTING BEAN AS RELATED TO FEATHERING

There are two general methods (6) of curing coffee after the ripe pods or cherries have been picked from the trees. In countries such as Brazil which have a dry period during the harvest season they spread the ripe cherries out on drying floors to dry in the sun until the flesh which surrounds the coffee beans becomes a dry, shriveled shuck. The beans are then threshed free of the brittle shucks and after being screened for size and hand picked to remove imperfections are ready for market. This is known as the dry method of curing, as opposed to the wet method used in damper climate like that of Colombia.

In the wet method of curing the freshly picked cherries are first put through a machine which removes the greater part of the flesh. They are then placed in cistern-like reservoirs full of water where the remaining flesh is removed by controlled fermentation. This fermentation not only breaks

down the remaining flesh but also loosens a parchment-like skin that surrounds the beans. The beans are then artificially dried and screened.

The curing of the coffee has considerable influence upon the flavor characteristics of the bean. Brazil produces approximately two thirds of the world's supply of coffee, most of which is cured by the dry method, whereas Colombia, the next largest producer of coffee, due to its climatic conditions, uses the wet method.

Most of the better quality brands of coffee are for the most part blends of Santos and Colombian coffees. Bourbon Santos is a term used to describe the coffee which grows on the younger Santos type trees, a superior product to that grown on the older trees. Unwashed Salvador is a dry-cured coffee similar to the Bourbon Santos. The Maracaibo comes out of the port of Maracaibo, Venezuela.

Coffee is roasted to produce the desired flavor. Up to a certain optimum point the roasting eliminates the raw acrid taste of the green coffee and develops the true characteristic flavor.

To determine what relations there may be between the method of curing and the degree of roast of the bean to the feathering of cream, the tests recorded in Table 3 were made. The coffee was made by percolator method.

Although some differences were obtained in feathering tests using the different types of beans the data do not definitely indicate that the method of curing the bean has a relation to the occurrence of feathering. Unfortunately, it was not possible to secure samples of the same coffee cured by both the wet and dry methods. Such samples, if available, might make it possible to detect a minor difference that would not be evident otherwise.

In the case of the degree of roast, however, the data show rather clearly that the more roasting the bean is subjected to the less tendency there is for feathering to occur. The explanation for this effect is to be found in the higher pH value of the brews made from the beans receiving the most roasting.

TABLE 3

Effect of method of curing bean and degree of roast upon pH of brew and extent of feathering*

Bean	Light roast		Medium roast		Dark roast	
	Score	pH	Score	pH	Score	pH
Bourbon Santos	114.25	4.86	88.5	4.90	84.5	5.00
Colombian (Washed)	139.00	4.84	123	4.92	101	4.97
Unwashed Salvador	97.00	4.91	81	4.95	63	4.97
		Light medium roast		Medium dark roast		
		Score	pH	Score	pH	
Washed Maracaibo		73.5	4.97	18	5.09	
Natural Maracaibo		35	5.01	0	5.13	

* pH and score values represent the average values obtained with the coffee brews made with water Nos. 2, 4 and 5.

TABLE 4

Relation of amount of coffee used in brew to its tendency to feather

Coffee No.	Amount coffee	pH	Brew 3 ml. curd formed			pH	Brew 4 ml. curd formed			pH	Brew 5 ml. curd formed			Ave. pH
			145°	170°	195°		145°	170°	195°		145°	170°	195°	
12	1 tb.	5.04	0	0	0	4.99	0	0	11	4.92	0	6	16	4.98
	2 tb.	5.03	0	0	0	4.99	0	0	10	4.95	0	3	13	4.99
	3 tb.	5.07	0	0	0	5.03	0	0	10	5.00	0	2	10	5.03
15	1 tb.	5.02	0	0	4	5.00	0	2	11	4.91	1	12	14	4.98
	2 tb.	5.01	0	0	0	4.95	0	0	10	4.89	0	8	13	4.95
	3 tb.	4.98	0	0	3	4.94	0	3	10	4.91	0	10	13	4.94
6	1 tb.	4.91	0	0	7	4.78	0	8	15	4.79	3	11	15	4.83
	2 tb.	4.87	0	0	13	4.84	0	5	16	4.79	1	13	15	4.83
	3 tb.	4.89	0	0	14	4.81	0	8	16	4.80	1	13	17	4.83
9	1 tb.	4.81	0	0	4	4.79	0	2	11	4.72	0	4	14	4.77
	2 tb.	4.79	0	0	9	4.74	0	3	12	4.73	0	9	14	4.75
	3 tb.	4.82	0	0	6	4.79	0	8	12	4.77	0	8	14	4.79

METHOD OF MAKING THE COFFEE AS A FACTOR IN CREAM FEATHERING

Since methods of making coffee vary considerably with the ideas of the individual brewer, an attempt was made to determine to what extent such variations may be a factor in the cream feathering problem.

Amount of Coffee Used

The first variable studied was the amount of coffee used. Four coffees were used in this experiment, two that had been rated high from a feathering standpoint and two that had been rated rather low. The results of the feathering tests and the pH measurements of the brews are given in Table 4. It will be observed that there was no consistent variation in the effect of increasing the amount of coffee used in the brew upon the amount of curd formed, the tendency being towards uniformity in results. An explanation for these results is found in the pH measurements which show but slight differences in the brews containing varying amounts of coffee. Coffee brew undoubtedly contains a buffer substance in addition to the acid constituents which are present in more or less definite proportions regardless of the amount of coffee used.

Method of Preparing Brew

Coffee brews made from seven different coffees by three different methods —boil, percolator and dripolator—were compared for cream feathering tendencies, using water number 5. It will be noted from the data in Tables 5 and 7 that both pH and the extent of feathering varies but little with the method of preparing the brew although there is some indication that coffee made by the dripolator method will have a slightly lower pH and slightly greater feathering tendencies than that made by either the boil or percolator methods. Such differences may be attributed to variations in the extent to which certain volatile acids such as acetic are retained by the brew.

Age of Coffee as a Factor

If we are to believe the advertising propaganda of the coffee industry, coffees undergo certain chemical changes during storage that materially affect their quality. Though most investigations attribute the age deterioration of coffee to oxidation of the fatty constituents, Prescott (5) *et al.* are of the opinion that furfuryl alcohol plays an important part in the staleness of coffee. To determine to what extent age of the coffee may be a factor in cream feathering samples of varying age were secured from five different companies. It will be noted from the data in Table 6 that without exception the brews made from the older coffees had a lower pH and as would be expected the general tendency was for a greater feathering from these brews. It is also interesting to note that the coffee substitute responded in the same way as the coffees as far as pH and feathering were concerned. These data

TABLE 5

Relation of method of making coffee to degree of cream feathering
(Water No. 5 used)

Coffee Brand No.	pH	*Boil* ml. curd formed			Score	pH	*Percolator* ml. curd formed			Score	pH	*Dripolator* ml. curd formed			Score
		195°	170°	145°			195°	170°	145°			195°	170°	145°	
4	4.72	15	9	4	49	4.70	15	9	5	53	4.72	15	10	9	68
11	4.90	12	6	0	24	4.90	8	9	0	26	4.87	14	7	0	28
10	4.95	12	10	0	32	4.91	9	7.5	0	24	4.89	13	9	0	31
10a	4.91	13.5	11	0	35.5	4.91	13	8.5	0	30	4.85	12	10	3	44
10b	4.85	13	12	3	49	4.82	14	11	5	56	4.85	16	6	5	48
10c	4.92	13	10	0	33	4.90	13	8	0	29	4.90	10	10	0	30
10d	4.94	13	0	0	13	4.95	7	2	0	11	4.97	13	0	0	13
Ave.	4.88				33.6	4.87				32.7	4.86				37.4

TABLE 6

Effect of age of coffee upon pH of brew and its tendency to cause feathering

Coffee No.	pH		ml. of feathering						Score
			195° F.		170° F.		145° F.		
	Brew 3	Brew 5	Brew 3	Brew 5	Brew 3	Brew 5	Brew 3	Brew 5	
4									
a. Fresh	4.80	4.76	14	16	10	13	0	8	166
b. 2 years old	4.75	4.69	14	15	5	10	0	10	142
Coffee substitute									
a. Fresh	4.85	4.84	5	16	1	12	0	0	60
b. One year old	4.83	4.80	12	16	3	15	0	0	97
10									
a. Fresh	5.00	4.91	0	9	0	7.5	0	0	24
b. 5 months old	4.87	4.80	7	14	6	9	0	0	83
11									
a. Fresh	4.95	4.90	6	8	0	9	0	0	44
b. 5 months old	4.85	4.78	8	15	2	11.5	0	4	88
1									
a. Fresh	4.80	4.78	13	15	0	11	0	0	76
b. 6 months old	4.79	4.77	9	15	3	11	0	3	91
c. 4 years old	4.73	4.70	14	15	7	11	0	6	138

TABLE 7

Comparison of the degree of feathering when adding cream to coffee or coffee to cream (Water V used)

Coffee number	pH	Cream to coffee ml curd formed			Score	Coffee to cream ml curd formed			Score
		195° F.	170° F.	145° F.		195° F.	170° F.	145° F.	
				A—Percolator method					
4	4.70	15	9	5	53	15	12	12.5	88
11	4.90	8	9	0	26	9.5	12	0	33.5
10	4.91	9	7.5	0	24	9	10	0	29.0
a	4.91	13	8.5	0	30	13	9	0	31
b	4.82	14	11	5	56	12	11	3	46
c	4.90	13	8	0	29	13	9	0	31
d	4.95	7	2	0	11	6	5	0	16
Ave.					32.7				39.2
				B—Boil method					
4	4.72	15	9	4	49	14	12	10	78
11	4.90	12	6	0	24	13	9	0	31
10	4.95	12	10	0	32	13	7	0	27
a	4.91	13.5	11	0	35.5	13	12	0	37
b	4.85	13	12	3	49	14	12	10	38
c	4.92	13	10	0	33	13	11	0	35
d	4.94	13	0	0	13	12	4	0	20
Ave.					33.6				38
				C—Dripolator					
4	4.72	15	10	9	68	14	14	11	86
11	4.87	14	7	0	28	12	14	6	64
10	4.89	13	9	0	31	12	7	0	26
a	4.85	12	10	3	44	13.5	6	0	25.5
b	4.85	16	6	5	48	15.5	11	8	48
c	4.90	10	10	0	30	16	13	0	42
d	4.97	13	0	0	13	12	4	0	20
Ave.					37.4				44.4

indicate that certain chemical changes likely occur during the storage of the coffee that accentuates the beans' effect upon cream feathering. No attempt was made to determine the nature of this change.

Method of Combining Cream with the Coffee Brew

The usual procedure in hotel and restaurant service is to add the cream to the coffee, although in some cases the reverse is true. That the former method might be expected to produce somewhat less feathering is indicated by the data in Table 7. Although the differences were not great a distinct trend will be noted toward greater feathering when the hot coffee was added to the cream. That the significant factor is the rapidity with which the coffee and cream mix when combined is illustrated by the fact that creams which ordinarily do not feather may be made to do so by slowly adding the cream to the coffee so that it more or less floats on the surface. This is particularly true when the quantity of cream added is less than ordinary.

CONCLUSIONS

In comparing the feathering tendencies of the brew made from 26 different brands of coffee the following conclusions are drawn:

1. Some coffees are more likely to cause feathering than others. This difference is likely due to variations in the pH of the brews resulting from variations in the soluble acids present in the beans.
2. It could not be shown that the method of curing the beans has any relation to the pH of the brew and feathering.
3. The degree of roast to which the bean is subjected affects feathering. The more roasting the bean is subjected to the higher the pH of the brew and the less the degree of feathering.
4. The concentration of the coffee in the brew has no definite relation to feathering.
5. The method of brewing, i.e., boil, percolator or dripolator, is not of great importance although slightly more feathering was obtained with brews made by the dripolator method.
6. The brew made from aged coffee has a lower pH and is more likely to produce feathering than that made from fresh stock.
7. More feathering may result when the coffee is added to the cream than when the cream is added to the coffee. Rapidity of mixing is thought to be the limiting factor.

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THE THIRTY-THIRD ANNUAL MEETING OF THE AMERICAN DAIRY SCIENCE ASSOCIATION

R. B. STOLTZ
Secretary-Treasurer

The American Dairy Science Association was called to order by the President, H. W. Gregory, in Campbell Hall on the campus of the Ohio State University on Tuesday morning, June 14, 1938, at 10:30 A. M., for the thirty-third annual meeting.

The program printed in the May issue of the Journal of Dairy Science was arranged by a program committee headed by Dr. T. S. Sutton. The May issue of the Journal also contained the abstracts of the various papers presented.

Vice-President Lewis L. Morrill, Ohio State University, gave an address of welcome. President H. W. Gregory gave the following response:

PRESIDENT'S ADDRESS

"Today our Association meets for the thirty-third annual meeting and it is interesting to note that we have among our membership a number of men, who laid the early foundation for the American Dairy Science Association, still taking a very active part in the Association.

In 1906, when the American Dairy Science Association was first started under the name of "The Official Dairy Instructors' Association," our problems were somewhat different from those we have before us today. The name of our Association in the beginning was very descriptive of one of our early problems which was "what to teach and how to teach it." If we read available dairy reports, catalogue descriptions of courses offered in dairying, note equipment used in our dairy laboratories in our agricultural colleges at the time our Association started, and compare the dairy curricula and facilities for research at the present time in our schools, we realize the development that has taken place during this comparatively short period in the dairy industry. This Association has played a very important part in bringing about these changes. Our industry has been and is being revolutionized by science. We who are connected with the dairy industry are constantly called upon to readjust our thinking and methods of teaching as progress is made in dairy research. Due largely to many new developments in our industry and improved methods of teaching, a number of our members have expressed an interest in having a committee of this Association study the dairy curricula offered in our different institutions. A rather comprehensive committee was appointed rather late in the year for this purpose and a complete report cannot be expected this year, but with the enthusiasm and interest of Dr. H. B.

Ellenberger, general chairman of this committee, I am sure we can look forward to a later report which will be of considerable interest to a large number of our members.

Our organization has always given a great deal of attention to problems relating to inspection, sanitation, standardization of equipment, methods and products. In 1911, as a result of the activities of a committee from this Association, the first draft of standardizing testing glassware was made, and later a number of states passed what is generally called a milk and cream testers' license law, requiring the use of standardized glassware. A resolution made by the committee on sanitary procedure of the International Association of Milk Dealers was sent to this Association during the year, calling attention to the need of cooperation in problems having to do with sanitation. This resolution recommended that a program be undertaken cooperatively to determine good industry practices by survey and by original research by national dairy organizations interested. Mr. Ernest Kelly, Assistant Chief of the Bureau of Dairy Industry, United States Department of Agriculture, was appointed chairman of the committee to represent the American Dairy Science Association on this important project.

During the early history of our Association we gave considerable attention to dairy laws, rules, and regulations, especially those enforced by our state and city governments. Due to improvement in our methods of production, processing and improvement in transportation facilities for milk and cream, a large amount of these products today enters into interstate commerce. Many of the states have milk and cream testers' license laws, state cream grading laws, and state laws relating to methods and equipment used in production. There is very little uniformity in the different state dairy laws and if there were the enforcement in the different states would not likely be uniform. Dut to this increased interstate traffic of milk and cream, are we not in need of a federal law which would give some federal agency jurisdiction in such shipments of milk and cream regarding the weighing, testing, and grading, especially when cream or milk originates in a state which enforces such state laws? A federal agency having jurisdiction over interstate shipments would tend to bring about uniformity of state dairy laws, would be a great aid to states now enforcing testing, grading and sanitary laws, and would be an encouragement to the dairy industry in those states that do not have such laws to propose similar laws to their legislatures.

As our Association increases in membership and importance the demand for the American Dairy Science Association to approve or condemn certain proceedings, methods or statements is increasing, and while the policy of this Association has been very conservative along this line, there has not been any definite procedure to follow in securing approval of this

EARL WEAVER, PRESIDENT

Association for such requests. Last year a committee was appointed at our annual meeting to give this consideration and suggest a procedure to be followed when such requests are submitted to the Association or any section of the Association. This committee has made its report which will be considered by the directors, and I hope that from this report the Association will be able to adopt a definite policy in handling such requests in the future.

There has been considerable interest among the membership in forming junior chapters of the American Dairy Science Association. Prof. J. A. Nelson, member of the Board of Directors, has attempted to make a survey this year to find out how general is the demand for such an organization, and also to determine what degree of success similar organizations have had in forming such chapters. If the Board of Directors thinks that there is enough interest in junior or local chapters of the Association, after considering Professor Nelson's report, recommendation for adopting such a procedure will be made to the Association.

Last February I received a letter from Dr. A. C. Dahlberg, editor of our Journal, stating that he did not wish to be reappointed as editor of the JOURNAL OF DAIRY SCIENCE. During the ten years Doctor Dahlberg has been editor our Journal has continued to increase in importance and recognition in the scientific field. Research articles in the Journal have increased over 50 per cent. The Journal was changed from six to twelve issues yearly. Abstracts of literature on dairy cattle and literature reviewing articles on timely, selected topics are only a few of the many services added to the Journal in the last few years. No one thing indicates the sound basis on which the Journal has been built better than the fact that all these services have been added without increasing the annual dues. These extra services have demanded more and more time of the editor in reading manuscripts, galley proofs, indexing of articles, and increased correspondence until it is nearly impossible to handle the Journal incidental to one's work. Doctor Dahlberg stated that it is with a real sense of personal loss and regret that he asked to be relieved of the position of editor.

A meeting of the Journal Management Committee, Doctor Dahlberg and myself, was held in Chicago, March 5, 1938, at which time the position of editor for the Journal was gone over very thoroughly with Doctor Dahlberg with the hope that some arrangement might be made so that he would continue as editor. Upon the insistance of Doctor Dahlberg, that his resignation be accepted and a new editor be secured, the Journal Management Committee was asked to give consideration to the securing of an editor for the JOURNAL OF DAIRY SCIENCE and to make recommendations in time to submit to the Board of Directors at the annual meeting in June.

Doctor Dahlberg has been a very capable editor. He has spared neither time nor effort to make the Journal a success, and our Association greatly appreciates the splendid services he has rendered the Association as editor and regrets that he considers it necessary to resign at this time.

Our Association has been growing rapidly and a great deal of time in the last few years has been given to improving our organization and getting it on a good operating basis. There is no better evidence of the success of our efforts in this direction than the secretary-treasurer's report for the year ending December 31, 1937, which shows our total assets now amount to a little over $17,000, $9,000 of which is invested in government bonds. The public accountant, who was secured to audit our books for 1937, makes the following statement in his report: "The comparative profit and loss statement reveals the changes in this year's business as compared to the two previous years. The income of 1937 exceeded the income of 1935 by $4,610.38. Although the increase over 1936 was only $1,305.28, it is interesting to note that there was a switch from associate subscribers to members and subscribers. Advertising increased $992.93, while operating expenses for the period increased only $296.78. These results indicate that the Association is arriving at the point of economical operation when the profits were increased $1,305.38 over the previous year with an increase in expense of only 22.7 per cent."

Our secretary-treasurer, Prof. R. B. Stoltz, deserves a great deal of credit for the interest, time and effort he has devoted to the American Dairy Science Association and the business management of our Journal. At the present time we have 1037 members and 825 subscribers, and our secretary hopes that by the end of the year the number receiving the Journal will increase to at least 2000. To keep our Journal on a sound financial basis and make the improvements that are desired, membership and subscriptions are very necessary. Due to the fact that our membership is widely scattered, the maintaining or increasing of our membership in this association must be done largely by individual members accepting some responsibility in securing members or subscribers. In January, this year, a representative in each state where we have members or subscribers was appointed with the hope that these representatives would make a special effort to see that those who are eligible would have an opportunity to subscribe to our Journal. Due to the rapid development and changes in our industry, there are a number of problems which many of our members believe should have the attention of our Association, but because of lack of time, finances, etc., we have not been able to give all these problems the consideration they deserve.

At this time I wish to express my personal appreciation to the numerous individuals, committees and officers of this Association for their assistance and cooperation during the year, and, especially, I wish to

commend Dr. T. S. Sutton and his committee for getting together our annual program in time to have it published and in the hands of our members several weeks before the annual meeting. This policy followed by our program committee has already added a great deal to our meeting and evidence of the value of such a procedure will undoubtedly be more in evidence before our meeting closes.

GUEST SPEAKER

Dr. K. Hickman, of the Eastman Kodak Company, Rochester, New York, was then introduced and gave a most interesting and instructive talk on "Vacuum Extraction of Accessory Food Factors."

ATTENDANCE

According to J. H. Erb, who had charge of the registration, the attendance showed that there were 620 registered, which is the largest registration at any of our annual meetings. Thirty-nine states, the District of Columbia, Canada and two foreign countries were represented. There were 358 members, 89 non-members, 125 ladies and 48 children registered.

S. M. Salisbury, chairman of the committee to submit new by-laws, presented mimeographed copies of the by-laws to each person present, and it was announced that these by-laws would be discussed and voted upon at the business session Thursday at 3:30.

After lunch the program as outlined was followed.

Tuesday evening the President of the University and the Dean of the College of Agriculture gave a reception for the Association at the Faculty Club.

Wednesday, June 15, the papers were read as provided for in the program. The men were given a complimentary barbecue lunch in the judging pavilion. In the evening the visitors were entertained in University Hall by a "rube" band and colored movie films of a trip around the world. They then were entertained in the natatorium by a diving and swimming exhibition. Following the evening entertainment a social time was then had between the natatorium and gymnasium.

On Thursday, June 16, papers were read and the business session was provided for as in the program. Thursday evening the annual banquet was given at the Neil House.

The ladies and children were entertained as provided for in the program published in the May Journal.

GENERAL BUSINESS MEETING

American Dairy Science Association

Columbus, Ohio, June 16, 1938

President Gregory called the meeting to order at 3:30 P. M., in the auditorium of Campbell Hall, Ohio State University, on Thursday, June 16, 1938. One hundred twenty-seven members were present.

The secretary-treasurer read the financial report which had previously been approved by the Board of Directors. Upon motion duly seconded the report was accepted and referred to the Auditing Committee.

Herbert Otting, chairman of the Auditing Committee, then gave the following report:

Columbus, Ohio
April 13, 1938

To the Members of the
American Dairy Science Assn.:
Gentlemen:

The Auditing Committee of the American Dairy Science Association has made an examination of the books and statements of the Secretary-Treasurer as of December 31, 1937.

It is our opinion, based upon such examination, that the books have been kept accurately and that the balance sheet and related summary of profit and loss fairly present the financial condition of the American Dairy Science Association.

Respectfully submitted,
T. S. Sutton
W. L. Slatter
H. E. Otting, *Chairman*

CIRCULATION OF JOURNAL

The Secretary then submitted a map of the United States showing the circulation of the Journal in each state and the allotted number which was obtained by dividing the population for each by 50,000 persons. The District of Columbia had the highest circulation, and Vermont was the highest state having a circulation of 21 and an allotment of 7. The states leading in total circulation are as follows: Ohio, 157; New York, 154; Illinois, 114; Pennsylvania, 94; California, 90; Massachusetts and Wisconsin, 56; Minnesota, 50; Michigan and District of Columbia, 49. At the present time the total circulation is 1898 of which 1073 are members, 704 subscribers and 121 associate subscribers. At the annual meeting a year ago the total circulation was 1741, or 157 less than today.

Thus far this year we have obtained 215 new members. These new members are from the following states: Ohio, 65; New York, 15; Pennsylvania, 14; Massachusetts, 12; Maryland, 10; California, 9; Michigan and Indiana, 8; Vermont, 6; Washington, Utah and Illinois, 5; Canada, Wis-

consin, New Jersey, Minnesota, Iowa, Dist. of Columbia and Connecticut, 4; Missouri and Tennessee, 3; and 19 scattered.

The problem of membership is that we have such a large number of members that lapse each year. If the students graduating from the various dairy schools were educated to the idea that in order to keep up with the times and prevent themselves from falling in a rut, it is essential that they affiliate themselves with this Association, you would be doing your students a great favor and the problem of recruiting new members would be solved.

REPRINTS FOR BULLETINS

Many experiment stations and colleges are now using reprints from the JOURNAL OF DAIRY SCIENCE instead of having technical bulletins printed. It is much less expensive for you to buy reprints from the JOURNAL OF DAIRY SCIENCE after having had an article accepted, than it is to print your own bulletins.

MORE ACTIVITY IN THE PRODUCTION FIELD

The Association is now printing abstracts in the field of dairy production. An effort should be made to obtain advertising from the breed associations, from companies manufacturing dairy feeds and other equipment for dairy cows. An effort should also be made to increase our membership among commercial men in the field of production.

Early this year the wife of a college graduate presented her husband with a membership in the Association for his wedding anniversary gift. With such a helpmate, he will not be permitted to fall in the rut.

PRODUCTION SECTION

Mr. W. E. Krauss, chairman of the Production Section, read the following report:

The Production section held five sessions at the regularly scheduled hours and places with the Section chairman, W. E. Krauss in the chair for the Symposium on Nutrition; H. W. Cave, chairman for the pasture, hay and silage session; W. E. Krauss, chairman for the vitamin and mineral session, the milk secretion, metabolism and udder disease session; and J. B. Fitch, chairman for the final session on Thursday afternoon.

All sessions were very well attended, at times almost taxing the seating capacity of 200 in Room 100 of the Botany and Zoology Building, where the sessions were held. The papers presented were without exception well prepared, well presented and in most cases accompanied by slides, mimeographed charts and tables, or other illustrated material. The availability of the printed abstracts in the hands of the members was commented upon by many as being a material help in following the presentation of the wide range of subjects reported upon.

All but two of the papers listed on the printed program were presented. The marked program attached indicates the author making the actual presentation.

The business meeting of the Production Section was called at 4:15 on Wednesday afternoon. The minutes of the 1937 meeting at Lincoln, Nebraska, were read and approved.

Reports were submitted by the various standing committees and approved at the time, or in a short additional business meeting held at 11:30 on Thursday morning. Copies of these reports are attached.

Points of particular interest incorporated in the reports follow:

Breeds Relations Committee, C. N. Shepardson, chairman.

1. The cow year method of calculating herd averages was approved.
2. The feeding or injection of thyroxine to cows on official test was considered an undesirable and unacceptable practice.
3. It was suggested that no changes be made in the uniform herd test blank.

Committee on Rules for Conduct of the Students National Dairy Cattle Judging Contest, I. W. Rupel, chairman.

It was recommended:

1. To use numbers instead of letters in designating animals.
2. To change the score card for grading oral reasons (copy attached).

Committee on Awards for the Students National Judging Contest, A. A. Borland, chairman.

It was recommended:

To attempt to increase the number of scholarships available for winners in the Students National Judging Contest.

Committee on Methods of Measuring Results of Pasture Investigations, R. N. Lush, chairman (presented by G. Bohstedt).

Two items were emphasized:

1. Conditions for collecting samples, especially for mineral analysis, were enumerated.
2. A study of the size and number of clip plots is to receive continued attention.

Committee on Standard Methods, A. E. Perkins, chairman.

It was recommended:

That the committee be increased to include a specialist in the following fields:

a. Milk analysis
b. Blood and urine analysis
c. Feeds and feces
d. Endocrines
e. Vitamins
f. Enzymes

The chairman of the Production Section will appoint additional members to this committee after due consideration.

All standing committees were reappointed with their present personnel except for the Breeds Relations Committee. E. E. Heizer and W. L. Crandall were appointed for a period of three years to replace C. N. Shepardson and E. N. Schultz whose terms expired. H. A. Herman was appointed for a period of two years to replace Earl Weaver who resigned.

A. C. Ragsdale, chairman of the Nominating Committee, presented names for the offices of vice-chairman and secretary for 1939. A. H. Kuhlman of Oklahoma was elected vice-chairman, and A. L. Beam of Pennsylvania was elected Secretary. H. W. Cave of Kansas, vice-chairman for this year, automatically becomes chairman for 1939.

Respectfully submitted,

W. E. KRAUSS, *Chairman*

I. R. JONES, *Secretary.*

Upon motion duly seconded the report was accepted.

EXTENSION SECTION

E. N. Shultz, chairman of the Extension Section, submitted the following report:

The proceedings of the annual meeting of the Extension Section of the American Dairy Science Association were held June 14, 15 and 16, 1938, in the Horticulture Building of the Ohio State University at Columbus, Ohio, with Earl N. Shultz, chairman of the Section, presiding.

The program was organized and conducted under the direction of a program committee consisting of C. L. Blackman, Ohio State University; R. G. Connelly, Virginia Polytechnic Institute, and S. J. Brownell, Cornell University.

Twenty papers were presented and discussed during the sessions with an average attendance of eighty-six people. An instructive exhibition of extension educational methods and results was organized and presented by the Exhibits Committee composed of E. C. Scheidenhelm, Michigan State College; A. J. Cramer, University of Wisconsin; Floyd Arnold, Iowa State College; Leland Lamb, Cornell University. The states that furnished exhibits were: Massachusetts, New York, Connecticut, Virginia, Tennessee, National Dairy Council, Michigan, Vermont, Wisconsin, Kansas and Iowa. The field application of each exhibit was discussed before an audience of forty-five extension dairymen and others.

The general program committee was ably assisted by collaborating committees on Extension Exhibits, Dairy Cattle Breeding, Dairy Cattle Feeding, Production Testing, 4-H Dairy Clubs, Dairy Quality Improvement, Resolutions and Nominations. The chairmen of the committees presided for the presentation of their respective committee papers. The per-

sonnel of the committees, the title of papers and subjects and the schedules followed are indicated in the official American Dairy Science Association program.

The annual business meeting of the Extension Section was held Wednesday, June 15, 1938, at 4:00 P. M., in the Ohio State University Horticulture Building. At this meeting the following resolutions were adopted.

1. Whereas the officers and the Extension Section Program Committee, C. L. Blackman, Ohio State University; R. G. Connelly, Virginia Polytechnic Institute, and S. J. Brownell, Cornell University, contributed much time and thought to planning and developing this year's program, and as a result of their efforts a constructive program was evolved; therefore, be it resolved that we commend these officers and the program committee, and also the chairmen and members of the collaborating committees, for their fine accomplishments, and thank those who prepared papers and furnished exhibits. Furthermore, be it resolved that the extension exhibits be continued next year with a wider participation by the States.

2. The members of the Extension Section wish to thank the members of the faculty of the Animal Husbandry, the Dairy Production, and Dairy Technology Departments of the Ohio State University for the fine facilities placed at our disposal and the many courtesies extended to us, both of which have helped to make our meetings successful and enjoyable; therefore, be it resolved that a copy of this resolution be sent to Professors C. W. Gay, R. B. Stoltz and S. M. Salisbury and the Ohio Agricultural Experiment Station.

3. Whereas uniform rules and regulations for conducting Dairy Herd Improvement Associations were adopted by the Extension Section of the American Dairy Science Association one year ago and published and widely distributed by the United States Bureau of Dairy Industry, and whereas these regulations have been adopted in the main by most of the States; and whereas this Committee believes that the complete adoption of such rules would strengthen confidence in the Dairy Herd Improvement Association work throughout the country; therefore, be it resolved that the Extension Section urge all the States to put these regulations into effect.

4. Whereas the identification and permanent herd record program is now well underway with satisfactory results, and whereas the system was evolved after much effort, discussion and trial; therefore, be it resolved that we express our appreciation to the Bureau of Dairy Industry in general and to Dr. J. F. Kendrick, Chief, Division of Dairy Herd Improvement Association Investigations, in particular for the prompt and complete manner in which the records have been returned to the States.

A new secretary is elected for the Section each year and the other

officers are promoted, with the retirement of the incumbent president. O. J. Hill, Washington State College, was elected secretary, R. G. Connelly, Virginia Polytechnic Institute, succeeded to the office of vice-chairman and S. J. Brownell, Cornell University, became chairman of the Extension Section for 1939.

EARL N. SHULTZ
R. G. CONNELLY, *Secretary*

MANUFACTURING SECTION

B. E. Horrall, secretary of the Manufacturing Section, submitted the following report:

The Manufacturing Section held its meetings at the place and time indicated in the official program. All of the papers listed were presented with the exception of M-28, M-31 and M-37. The papers were very instructive and all of the sessions were well attended.

A motion was made to elect a vice-chairman in addition to a chairman and secretary this year. For succeeding years only a vice-chairman, who would automatically become chairman the forthcoming year, and a secretary would be elected. The motion was seconded and carried.

Reports were heard from the following committees:

1. Chemical Methods for the Analysis of Milk and Dairy Products
2. Quality Program for Dairy Products
3. Judging Dairy Products
4. Methods of Determining the Curd Tension of Milk
5. Score Cards for Sanitary Inspection of Dairy Farms and Milk Plants
6. Methods for Measuring the Oxidation of Milk Fat
7. Methods for the Bacteriological Analysis of Milk and Dairy Products. A financial report was also given for the sale of Bacteriological reports.

P. A. Downs of Nebraska was elected chairman; F. H. Herzer of Mississippi, vice-chairman; and J. I. Keith of Oklahoma, secretary, for the forthcoming year.

C. J. BABCOCK, *Chairman*
B. E. HORRALL, *Secretary*

COMMITTEE REPORTS

T. S. Sutton, chairman of the Program Committee, submitted the report for the committee as read in the minutes of the Board of Directors. Upon motion duly seconded the report was adopted.

In the absence of S. M. Salisbury, the by-laws, as read in the minutes of the Board of Directors, were presented by Secretary Stoltz, and upon motion duly seconded they were adopted.

PROPOSED BY-LAWS OF THE AMERICAN DAIRY SCIENCE ASSOCIATION

ARTICLE I—MEMBERSHIP

Section 1. Any person is eligible to membership who is formally announced by an Agricultural College or Experiment Station, or by the Bureau of Dairy Industry of the United States Department of Agriculture or by the Canadian Department of Agriculture as an instructor, extension worker, investigator, or administrative officer connected with the dairy industry, or any person filling a position of responsibility connected with the dairy industry who has had a college or university training in technical science, or any person filling a responsible position in the dairy industry of a professional character requiring a technical knowledge of dairying of a high order.

Section 2. Nominations for membership shall be submitted to the Secretary-Treasurer in writing signed by the applicant and endorsed by at least one member. In case of uncertainty regarding the eligibility of the applicant for membership, the Secretary-Treasurer shall refer the application to the Board of Directors for decision. Upon receiving the approval of the Secretary-Treasurer, or the Board of Directors, when the application has been referred to them for action, and the payment of the membership fee and dues, the applicant shall be enrolled as a member of the Association.

Section 3. The membership fee shall be set by the Board of Directors and shall be payable with the application for membership.

Section 4. The annual dues shall be set by the Board of Directors and shall be payable on or before January first of each year.

Section 5. Any member of the association in arrears for dues for more than one year shall cease to be a member of the association but may be restored without the formality of re-election by payment of all arrears including the current dues.

ARTICLE II—OFFICERS

Section 1. The officers of the Association shall be President, Vice-President, Secretary-Treasurer, Journal Editor and a Board of Directors.

The Vice-President shall be elected by the vote of the membership and his term of office shall be for one year beginning October first following his election. On the completion of his term of office as Vice-President he shall automatically become President for one year, or until his successor is duly chosen. The Secretary-Treasurer and the Journal Editor shall be elected by the Board of Directors for such term of office as the Board of Directors shall prescribe.

Section 2. The Board of Directors shall consist of ten members: six to be elected by the membership, the retiring President, the President, the

Vice-President, and the Secretary-Treasurer. The Secretary-Treasurer shall be an ex-officio member.

Two Directors shall be elected each year, whose terms of office shall be for three years. The terms of all Directors shall begin October 1, following election.

Section 3. The Board of Directors shall elect two members from the Association, who, with the Secretary-Treasurer as an ex-officio member, shall constitute the Journal Management Committee, which shall be responsible to the Board of Directors. The term of service of the elected members shall be at the discretion of the Board of Directors.

Section 4. The Board of Directors may constitute and appoint such committees not provided for in the By-Laws of the Association, as they may deem proper, from their own membership or from the membership of the Association.

Section 5. The Board of Directors shall have the authority to fill vacancies that may occur among the offices of the Association, such appointees to serve during the remainder of the unexpired term of the office in question.

ARTICLE III—DUTIES OF OFFICERS

Section 1. The President of the Association shall preside at all meetings of the Association and meetings of the Board of Directors and shall perform such other duties as pertain to that office. The Vice-President shall perform the duties of the President in the absence of the President.

Section 2. The Secretary-Treasurer shall have charge of the business management of the Association, shall have custody of the books and records of the Association, keep the minutes of all meetings of the Association and the Board of Directors, maintain a list of all members and subscribers, keep the funds of the Association, and make disbursements therefrom when properly authorized.

Section 3. The Journal Management Committee shall have the general supervision of the Journal. The Journal Editor under the general supervision of this Committee, shall have direct charge of all editorial details of the Journal.

Section 4. The Board of Directors shall pass upon all applications for divisions, sections, and student branches of the Association.

Section 5. The Board of Directors shall have full control of the business of the Corporation, and the title to all property and funds of the Association shall be vested in the Board of Directors. The Board of Directors shall have all the rights and powers vested in the Corporation by the laws of the District of Columbia.

ARTICLE IV—ELECTION OF OFFICERS

Section 1. On or before September 10, the Secretary shall mail to

each member a blank on which he shall be entitled to express his choice for each office to be filled. This blank shall give the report of the Nominating Committee which shall suggest the names of two members for each office to be filled. All ballots shall be counted by the Secretary and later verified by the President. In case no candidate has a majority by the first ballot, the tie shall be broken by the Board of Directors.

ARTICLE V—MEETINGS

Section 1. Meetings of the Association shall be held at the time and place fixed by the Board of Directors, but not less than one each calendar year shall be held. Notice of the time and place of meetings of the Association shall be given to all members not less than four weeks prior to the date of the meeting.

Section 2. Meetings of the Board of Directors shall be held upon call of the President provided, however, that not less than 10 days notice of such meeting shall be sent to each member of the Board of Directors.

Section 3. The quorum of any meeting of the Association shall consist of not less than ten per cent (10%) of the membership.

ARTICLE VI—ORGANIZATION OF DIVISIONS, SECTIONS AND STUDENT BRANCHES

Section 1. Professional groups based on geographical considerations to be known as divisions of the Association and to be organized by the members of the Association may be authorized by the Board of Directors when such action shall seem expedient. The officers of the division shall be a chairman, and such other officers as are provided by the division.

The divisions shall have the right to make by-laws for their own government which shall not be inconsistent with the charter and the by-laws of the Association.

Membership in divisions of the Association is open only to those regularly elected members of the Association.

Any division may raise or collect funds to be expended for its own purpose.

Section 2. Professional groups based upon specialized interests to be known as sections of the Association and to be formed by not less than ten members may be authorized by the Board of Directors when considered for the best interests of the Association.

Such sections may elect their own officers and may make rules for their own guidance not inconsistent with the charter and by-laws of the Association.

Section 3. Student branches at any agriculture college may be authorized by the Board of Directors on petition from at least ten students regularly enrolled in a four-year course in agriculture and majoring in

some phase of the dairy industry when their petition is recommended by two department members who are members of the Association.

ARTICLE VII—JOURNAL OF DAIRY SCIENCE

Section 1. The Journal of Dairy Science, published by the Association, shall be sent to each member, provided his dues are paid by January 10.

ARTICLE VIII—AMENDMENTS

Section 1. These by-laws may be amended at any meeting of the Association by an affirmative vote of two-thirds of those members present, provided that not less than 10% of the membership is present at the meeting.

All amendments must be referred to the Board of Directors for its recommendation prior to the final action by the Association. The Board of Directors may, at its discretion, submit proposed amendments which have received the approval of the Board, to the members of the Association for vote by mail. In such case, an affirmative vote of two-thirds of all voting, and which shall not be less than a majority of the membership, shall be necessary for approval.

Mr. O. F. Hunziker, chairman of the Journal Management Committee, gave a summary of the report which he had submitted to the Board of Directors. Upon motion duly seconded this report was approved.

Vice-President Weaver, chairman of a committee appointed to formulate a procedure whereby the sections and groups of the Association may secure Association approval of their actions before such actions are released for publication, submitted the report for the committee and upon motion duly seconded it was adopted. (Report will be found in minutes of the Board.)

J. A. Nelson submitted his report on junior chapters of the A. D. S. A. Upon motion duly seconded the report was adopted.

H. A. Ruehe, chairman of the Nominating Committee, submitted the following report:

The Committee on Nominations present the following nominations:

Vice-President	*Director*
E. S. Guthrie, Ithaca, N. Y.	M. E. Parker, Chicago, Ill.
J. A. Nelson, Bozeman, Montana	W. D. Dotterer, Chicago, Ill.

Director

C. S. Rhode, Urbana, Ill. J. W. Linn, Manhattan, Kansas

Respectfully submitted,

H. A. RUEHE, *Chairman* H. F. JUDKINS
D. R. THEOPHILUS J. B. FITCH
K. M. RENNER

Upon motion duly seconded the report was adopted and the committee discharged.

In the absence of Mr. H. P. Davis, Mr. H. C. Jackson submitted the report of the Resolutions Committee. The following report was read:

RESOLUTIONS

Whereas the American Dairy Science Association assembled at their thirty-third annual meeting at the Ohio State University has enjoyed a splendid program and many fine courtesies extended by faculty members of the various departments and their wives:

Therefore, Be it resolved:

That the membership of the American Dairy Science Association, their wives and families, wish to express their grateful appreciation to the staff of the Ohio State University, their wives and other organizations responsible for this entertainment.

Whereas the Borden Company has seen fit to continue their awards for outstanding research in the field of dairying:

Therefore, Be it resolved:

That the American Dairy Science Association again express its appreciation of this interest in dairy research.

Whereas from time to time variations in the manipulation of the Babcock test have been proposed:

Therefore, Be it resolved:

That the American Dairy Science Association make a comprehensive examination of the Babcock procedure for determining fat in milk and cream with the purpose of refining the technique, obtaining greater accuracy, reliability and uniformity without undue increase in complexity.

Whereas the Council on Foods of the American Medical Association has added oleomargarine to the approved list of foods and has removed butter from the same, and whereas all results of scientific investigation have shown the nutritional superiority of butter:

Therefore, Be it resolved:

That the American Dairy Science Association request the American Medical Association to request its Council on Foods to reconsider this action which may have such far reaching effects on a basic food industry.

Whereas the untimely passing of three of our esteemed members, Prof. E. B. Fitts of the Pennsylvania State College, Prof. Rush B. Locke of the Colorado State College, and E. S. Raven of the Raven Creamery, Portland, Oregon, has occurred during the past year, and whereas a keen sense of loss is felt by members of the American Dairy Science Association.

Therefore, Be it resolved:

That a recognition of this feeling be spread upon the records of the Association, and that the Secretary forward a copy of this resolution to the families of the deceased.

Whereas Dr. A. C. Dahlberg has asked to be relieved as editor of the JOURNAL OF DAIRY SCIENCE:

Therefore, Be it resolved:

That the membership of the American Dairy Science Association expresses its deepest regret that Doctor Dahlberg has felt it necessary to resign as editor of the JOURNAL OF DAIRY SCIENCE, a position which he has so bril-

liantly filled. The American Dairy Science Association further expresses its keenest appreciation of Doctor Dahlberg's ability as a scholar and scientist and its tribute to the great service rendered by him to this Association as Journal Editor.

Whereas the New York State Agriculture Experiment Station through its director has permitted Dr. A. C. Dahlberg to act through these years as Editor of the JOURNAL OF DAIRY SCIENCE:

Therefore, Be it resolved:

That the American Dairy Science Association express to Director Parrott and through him to the station, in regretfully accepting Doctor Dahlberg's resignation, its very great appreciation of the facilities provided and for giving the cooperation which has been so generously and graciously accorded the Journal Editor's office.

Respectfully submitted,
H. C. JACKSON
FORDYCE ELY
E. V. ELLINGTON
H. P. DAVIS

Upon motion duly seconded the report was adopted and the committee discharged.

The Secretary read the minutes of the Board of Directors and upon motion duly seconded the minutes were approved, and all action of the Directors during the past year were authorized and approved.

MEETING OF THE BOARD OF DIRECTORS
AMERICAN DAIRY SCIENCE ASSOCIATION
COLUMBUS, OHIO, JUNE 13, 1938

A meeting of the Board of Directors of the American Dairy Science Association was held in Townshend Hall, Monday evening, June 13, at 7:30 P.M. Present:—Pres. H. W. Gregory, Directors E. G. Hood, C. R. Gearhart, J. A. Nelson, C. E. Wylie, E. V. Ellington, H. Macy, and R. B. Stoltz. Absent:—Vice-President Earl Weaver and Director R. R. Graves.

O. F. Hunziker, chairman of the Journal Management Committee, appeared before the Board and gave a very comprehensive report discussing Journal finances (the additional annual cost for publication of abstracts of the literature on dairy cattle); recommendations for successor to Journal editor; budget for the office of editor; publication of abstracts of literature on dairy cattle; abstracts of annual meeting (one month in advance of the date of the meeting)—"Incidentally an unfortunate error occurred in the paging of the May issue of the Journal containing the abstracts of the annual meeting. The entire issue is paged for abstracts of literature instead of for main Journal text, as it should have been. This places the program and the original papers (abstracts of annual meeting) in the Abstract Section, which regularly consists of previously published material.

"This error which occurred during the Editor's absence due to serious illness, obviously cannot be undone. It is proposed, however, that this

material in the May Journal be considered for this year only in the Abstract Section. At the end of the year it will then be indexed in both the Abstract Section and in the section for original articles. While this makes the index for the section of the original articles somewhat cumbersome, confusion can be and will be avoided by using the letter "A" in front of the page and placing a footnote at the bottom of each page, stating that "A" refers to the Abstract Section.

"We propose also to make an announcement of this error at the General Session of this annual meeting, explaining to the membership the manner in which the matter will be taken care of. It was suggested that an insert be placed in the July issue making a statement regarding the renumbering of the pages."

Mr. Hunziker further discussed bids for printing the Journal; Reprints of chemical and bacteriological methods—"In the past the Chairman of the Committee on Laboratory Methods ordered a supply of reprints for distribution among members who wanted copies at 50¢ per copy, and the cost of these reprints was charged to the Journal with the understanding that after the committee chairman had sold a sufficient number, the Journal would be reimbursed out of such sale. As time went on the chairman developed a small fund which was maintained by the Committee to purchase reprints as issued.

"This appeared to work fairly satisfactorily but this service could obviously be improved by assisting the members in ordering reprints direct from the source of supply. In order to place this whole matter of reprints of chemical and bacteriological methods on a somewhat more business-like basis, your Committee recommends:

"1. That those interested in reprints on laboratory methods order the same direct from the Secretary-Treasurer, accompanying their order with remittance of the price per copy.

"2. That this change take effect at once.

"3. That announcement of this change be made at the general session of this annual meeting as well as in each issue of the Journal in which laboratory methods appear.

"4. That the chairmen of the Committees on Laboratory Methods be requested to transfer the fund that they may have accumulated from former sales of reprints to the Secretary-Treasurer.

"5. That the reprints in the hands of the chairman be transferred to the office of the Secretary and their availability be called to the attention of the members."

Further discussion covered insurance on back numbers of the Journal; publication of committee reports as follows:—"The Suggestion that committee reports of importance be published in the Journal originated with our Editor, Dr. Dahlberg. Your committee is heartily in favor of this

suggestion and we recommend it to this Board for consideration and approval. In the case of the Committee on Laboratory Methods, for instance, it is mandatory by vote of our Association, that reports after they have been accepted, be published in the Journal.

"There are other committee reports which are more or less official for our Association, and which are sufficiently important to merit a place in the Journal for similar reasons as prominence is given to any other original article. This would be true of reports for instance on dairy products standards, breed relation score cards and many other reports of similar importance.

"Your Committee, therefore, recommends that the Board of Directors, in case they are favorable to this suggestion, direct the committees of the Association to send their reports, after they have been finally approved by the Association, to the Journal Editor for publication in the Journal."

The concluding point concerned donations to other Journals.

Respectfully submitted,
A. A. BORLAND
R. B. STOLTZ
O. F. HUNZIKER, *Chairman*

Mr. Ellington moved and Mr. Gearhart seconded that the Board of Directors accept the resignation of Dr. Dahlberg and send him our regrets that he could not be present and to send the Board's appreciation of his services. Motion carried, and the following telegram was sent to him:

"It is with sincere regret that we received and accepted your resignation as Editor of the Journal of Dairy Science. We deeply deplore your unavoidable absence from our annual meeting due to ill health that is preventing you from receiving, in person, our expression of appreciation and our tribute to the great service you have rendered our Association as Journal Editor. Accept our earnest good wishes for your speedy and complete recovery."

BOARD OF DIRECTORS
American Dairy Science Association

It was moved by Mr. Wylie and seconded by Mr. Ellington that Dr. T. S. Sutton be employed as Editor of the Journal beginning July 1, 1938. Motion carried unanimously.

Mr. Nelson moved and Mr. Hood seconded that the Secretary be instructed to write to the Director of the New York State Agricultural Experiment Station the appreciation of this Board for making it possible for Doctor Dahlberg to serve as Editor and permitting clerical assistance for carrying on the work of the Editor of the Journal of Dairy Science during the past ten years. Motion carried. The following letter was sent:

"In accepting with regret Dr. A. C. Dahlberg's resignation as Editor of the Journal of Dairy Science, we desire to express to you our sincere appreciation and gratitude for the high privileges, helpful facilities and generous cooperation that the New York State Agricultural Experiment Station so freely accorded our Journal Editor's office for the lasting benefit of the Dairy industry."

BOARD OF DIRECTORS
American Dairy Science Association

Mr. Macy moved and Mr. Ellington seconded that the report pertaining to "reprints of chemical and bacteriological methods" be approved. Motion carried. Mr. Macy moved and Mr. Wylie seconded that the recommendation of the Journal Management Committee on publication of committee reports be approved as amended. Motion carried. Secretary Stoltz moved and Mr. Macy seconded that the report of the Journal Management Committee referring to donations to other Journals be approved. Motion carried. Mr. Macy moved and Mr. Wylie seconded that the report of the Journal Management Committee as amended be accepted. Motion carried.

The President appointed a committee to draw up a set of by-laws to replace our present by-laws, consisting of S. M. Salisbury, R. R. Graves, C. L. Roadhouse and R. B. Stoltz. These by-laws were submitted to the Board of Directors, and upon motion by Mr. Nelson and seconded by Mr. Wylie, it was recommended that the by-laws, as amended, be submitted to the membership for their approval. Motion carried.

The by-laws will be found printed in the minutes of Business Meeting.

President Gregory had previously appointed Mr. Macy to make a study of the rules concerning the Borden Award. He gave a report to the Board of Directors telling of how other associations handled similar awards. Mr. Wylie moved and Mr. Nelson seconded that President Gregory appoint a committee of three to draw up rules for the Borden Award. Motion carried. President Gregory appointed Mr. Macy, Mr. H. A. Ruehe and F. B. Morrison. The Board then adjourned.

MEETING OF THE BOARD OF DIRECTORS

COLUMBUS, OHIO, JUNE 14, 1938

A meeting of the Board of Directors of the American Dairy Science Association was held in Campbell Hall, Room 203, Tuesday, June 14, 1938, at 4:30 P.M. Present:—Pres. H. W. Gregory, Vice-Pres. Earl Weaver, Secretary Stoltz, E. G. Hood, C. E. Wylie, C. R. Gearhart, R. R. Graves, E. V. Ellington, and J. A. Nelson. Absent:—H. Macy.

Professor C. N. Shepardson of Texas appeared before the Board and extended the Association an invitation to hold their 1940 annual meeting in Texas. No action taken.

P. F. Sharp, chairman of the Committee on the Standardization of Market Milk, appeared before the Board and recommended the approval of the following report:

REPORT OF COMMITTEE ON STANDARDIZATION OF MARKET MILK
OHIO MEETING OF THE AMERICAN DAIRY SCIENCE ASSOCIATION,
JUNE 14–17, 1938

A committee of the American Dairy Science Association was appointed by H. A. Ruehe and continued by R. R. Graves, Presidents of the Association, to make recommendations regarding the mechanical standardization of market milk. At the meeting held in Lincoln, Nebraska, June, 1937, the recommendation of the committee was adopted, that a copy of its report be given to the members of the American Dairy Science Association as a preliminary to its consideration at the Ohio meeting.

Believing: that laws and regulations prohibiting the standardization of the fat content of market milk are unsound in principle as a means of protecting the consumer, and that legalization of the mechanical standardization of the fat content of market milk would remove an important economic restriction which operates to the mutual disadvantage of the farmer, the distributor and the consumer; the American Dairy Science Association approves and recommends in principle the following:

First: the legalization of the alteration of the fat content of market milk by mechanical standardization either up or down, by an amount not to exceed 0.6 per cent of fat, provided that all products used in standardization be at least equal in sanitary and physical quality and be held not longer than the milk to be standardized, and provided either that the minimum guaranteed fat content be stated on the label, or that classes or grade designations based on fat content be established and the class or grade designations corresponding to the legally established minimum levels of fat content be stated on the label.

Second: that the legal minimum for the solids-not-fat of milk be 8.15 per cent.

Third: That the legalization of the mechanical standardization of the solids-not-fat content of market milk by the addition of dried or condensed milk is inadvisable at this time.

A. D. BURKE
W. D. DOTTERRER
J. H. FRANDSEN
C. L. ROADHOUSE
P. F. SHARP, *Chairman*

Upon motion duly seconded the report was approved and referred to the membership for their action. The motion carried not unanimously.

The meeting then adjourned.

MEETING OF THE BOARD OF DIRECTORS
COLUMBUS, OHIO, JUNE 15, 1938

A meeting of the Board of Directors of the American Dairy Science Association was held in Townshend Hall, Wednesday, June 15, 1938, at 4 P.M. Present:—President H. W. Gregory, Vice-Pres. Earl Weaver, Secretary R. B. Stoltz, Directors J. A. Nelson, E. G. Hood, R. R. Graves, C. R. Gearhart and E. V. Ellington. Absent:—Directors H. Macy and C. E. Wylie.

The Secretary-Treasurer submitted the financial report which was sent to all directors in the month of February. Upon motion by Mr. Weaver and seconded by Mr. Graves this report was accepted and referred to the Auditing Committee. The report of the Auditing Committee was then read. Upon motion duly seconded the report of the Auditing Committee was accepted and referred to the Association. (Auditing Committee report may be found in minutes of the business meeting.)

G. M. Trout then appeared before the Board and requested the Board to give authority to the Dairy and Ice Cream Machinery and Supplies Association to publish the report of the judging of dairy products prepared by Mr. Trout in the Association Quarterly magazine. Upon motion duly seconded the Board of Directors approved the request.

Mr. Gearhart moved and Mr. Nelson seconded that the time of meeting at Washington and Idaho in 1939 be the week of June 26. Motion carried.

Mr. Nelson then reported on Student Branches of the A.D.S.A. Mr. Nelson moved and Mr. Graves seconded that the President appoint a committee of three to formulate a plan of junior chapters of the A.D.S.A. Motion carried. The President appointed Mr. Nelson of Montana, Mr. Ellington of Washington and Mr. Borland of Pennsylvania.

Mr. Weaver was then called upon to present a report of the committee appointed to formulate a procedure for various sections and groups of the Association. The report follows:

TENTATIVE REPORT

A committee consisting of J. A. Nelson, C. R. Gearhart and Earl Weaver was appointed by Pres. R. R. Graves in June 1937 to formulate procedure for various sections and groups of the Association to use in securing Association approval of such actions of these sections and groups as require such approval prior to their release for publication.

The committee proposes:

(1) Policy

(a) The action of any section or group which establishes grades or standards, prescribes methods for the conduct of tests or determinations, establishes regulation or in any other manner possesses

general interest may be published in such manner as deemed advisable subject to the approval of the Association in accordance with the provisions below.

(b) Association approval shall be construed as the favorable action of the membership in annual meeting or in cases of emergency of the favorable action of the Board of Directors. The decision as to the existence of an emergency shall rest with the President of the Association.

(c) No action of any section or group shall be purported to carry the Association approval until such approval has been granted.

(d) No action of any section or group shall be published in the Journal of Dairy Science until the Association shall have given its approval for such publication.

(e) Final judgment in respect to the advisability of publication in the Journal of Dairy Science of any action of the Association or of its sections and groups shall rest with the Board of Directors.

(2) Organization

(a) At the beginning of the Association year on October 1 the President shall appoint a general resolutions committee of five members to serve for that year.

(b) At the opening general session of each annual meeting the President shall have announced the time and place of the first meeting of the general resolutions committee.

(c) The chairman of each section and group shall be notified in advance of such subsequent meetings of the general resolutions committee as its chairman shall call during the period of the annual meeting.

(d) The general resolutions committee may submit a partial report at any general session during the annual meeting.

(3) Procedure

(a) It shall be the duty of the secretary of each section or group to transmit to the general resolutions committee or some member thereof, the action of his section or group upon which it is desired to receive Association approval.

(b) The general resolutions committee shall exercise its authority to reject the action thus transmitted or to submit it for the approval of the Association.

(c) Any member may submit from the floor of any meeting any matter upon which he desires to obtain Association action.

Signed: EARL WEAVER, *Chairman*
C. R. GEARHART
J. A. NELSON

Upon motion by Mr. Nelson and seconded by Mr. Ellington the report of the committee was approved.

MEETING OF THE BOARD OF DIRECTORS
COLUMBUS, OHIO, JUNE 16, 1938

A meeting of the Board of Directors of the American Dairy Science Association was held in Townshend Hall, Thursday, June 16, 1938 at 1:00 P.M. Present:—Pres. H. W. Gregory, Vice-Pres. Earl Weaver, Secretary Stoltz, E. G. Hood, J. A. Nelson, R. R. Graves, C. R. Gearhart. Absent:—C. E. Wylie and H. Macy.

The Program Committee gave the following report:

The Program Committee consisted of E. N. Shultz, W. E. Krauss, C. J. Babcock, with T. S. Sutton as Chairman; S. I. Bechdel and H. P. Davis were advisory members. The change in personnel of this committee from that of previous committees was made following a recommendation of the Program Committee of 1937. The present arrangement did not remove all the objections to the previous method of selecting the personnel of this committee. The other members of the committee are still located at considerable distance from the place of meeting. This year we were fortunate in having the chairman of the Production Section in this State and the chairman of the Manufacturing Section designated a member of the local Department of Dairy Technology to act for him in selecting and organizing papers for the Manufacturing Section.

The present Program Committee was handicapped for time. The Board of Directors adopted a resolution presented by the 1937 program committee, setting April 15 as the latest day for receiving titles and abstracts. A report of this action was published in the December issue of the Journal. The Journal Editor called for the program material on April 15, in order that it could appear as the May issue of the Journal.

Prior to April 15, the general program was organized and a definite time allotment set for papers voluntarily submitted. Papers were slow coming in; however, by the evening of the 15th, more papers than could be included in the time allotted were at hand. The recommendations of the 1937 program committee adopted by the Board of Directors provided means for making our decision on papers which were not included in the program. Papers which were received late (after April 15) were either included among those read by title or returned to the authors. Our program was organized, copied and in the mail to the Editor, April 16.

The present committee set the precedent in not including on the program all the papers submitted. The majority of the papers in the "read by title" group were so placed because of late arrival or duplication of authorship. For real effectiveness of the program, most eliminations should be made on the basis of the quality of the offering. We trust that future committees will be able to make more of their decisions on this basis.

The present program includes as special features, a symposium on nutrition, an education section and a general session at the Ohio Agricultural Experiment Station. Because of a lack of room facilities at the Experiment Station, it was impossible to schedule sectional meetings, and a program of general interest with invited speakers was decided upon. Our Wooster guests will have some time to inspect the experimental work in progress at the Station.

Because of the interest in artificial insemination an additional session of the Extension Section was scheduled for the discussion of this subject.

In order that the program committee may have more time for the careful consideration of the abstracts in making up the program, we recommend, that the last date for receiving abstracts be set some time in advance of the time the program must be submitted to the Editor. Such a date should be worked out by the chairman of the Program Committee and the Editor.

E. N. SHULTZ C. J. BABCOCK
W. E. KRAUSS T. S. SUTTON, *Chairman*

The meeting of the Board of Directors was then adjourned.

AMERICAN DAIRY SCIENCE ASSOCIATION PRESENTED BORDEN AWARDS TO K. G. WECKEL AND W. E. KRAUSS

AT THE

ANNUAL BANQUET

NEIL HOUSE

COLUMBUS, OHIO, JUNE 16, 1938

S. M. Salisbury, toastmaster, presented the officers and distinguished guests. He then introduced H. A. Ruehe, chairman of the Dairy Manufacturing Awards Committee, who made the following statement:

The Committee on the Borden Award in Dairy Manufacturers submits the following report:

According to the rules adopted by the Executive Board of the American Dairy Science Association, the Borden Award in Dairy Manufactures is awarded for outstanding research in the processing field such as improvement in equipment or methods in the handling of milk or cream and the production of milk products. The recipient must not have reached his fortieth birthday.

Your committee adhered rigidly to these rules in its consideration of nominees.

Your committee is pleased to announce that it has selected Dr. Kenneth G. Weckel, Dept. of Dairy Industry, University of Wisconsin, as the recipient of the Borden Award in Dairy Manufactures for the year 1938.

Doctor Weckel was selected on the basis of the significant contributions which he has made in the application of irradiation to the commercial dairy industry. He is responsible for the development of apparatus which has made the irradiation of milk commercially possible.

Doctor Weckel was born in Canton, Ohio, in 1906. He received his undergraduate training at the University of Wisconsin and was graduated with the Bachelor of Science degree with honors in 1931. He was granted the Master of Science degree in 1932, and the degree of Doctor of Philosophy in 1935 by this same institution.

Doctor Weckel has devoted his attention to the study of light and its relation to the vitamin D potency of dairy products. He is an authority in this field. The results of his research have appeared in many articles published both in scientific journals and trade papers. In all of his writings, as in his research, he has kept the practical application of his studies in mind, making it possible for the commercial industry to keep abreast with his scientific findings.

Dr. Kenneth G. Weckel has brought honor to himself and to the institution of which he is a member through his efforts and his desire to serve the dairy industry to the best of his ability.

Respectfully submitted,

M. E. PARKER H. L. RUSSELL

H. A. RUEHE, *Chairman*

KENNETH G. WECKEL

"Mr. Wentworth, it is now my pleasure to present to you as the recipient of this Award, Dr. Kenneth G. Weckel."

Mr. W. A. Wentworth, representing the Borden Company, then spoke as follows:

"Dr. Weckel, on behalf of The Borden Company I present this medal to you which is given in recognition of the fine work you have done in research.

"So that you and all those present may know the message which is conveyed with this medal, I should like to read from its reverse side:

> Award for Outstanding Achievement in Dairy Manufacturing Research to *Kenneth G. Weckel, 1938,* by Direction of American Dairy Science Association.

"Along with the medal goes a financial reward which we trust will be of value to you and possibly afford you an opportunity to possess some things which might not otherwise be available to you.

"The purpose of this award in addition to rewarding and recognizing you as an individual is to stimulate in others, the hundreds of them who are engaged in similar work throughout the United States and Canada, further constructive research in the dairy manufacturing field for the advancement of the industry.

"Dr. Weckel again on behalf of The Borden Company, I wish to congratulate you upon your own attainments which tonight are recognized by the American Dairy Science Association and particularly by those of that Association who are here tonight and who have so grandly indicated their concurrence in the grant of the award to you."

The toastmaster then introduced F. B. Morrison, chairman of the Production Award Committee, who gave the following report:

The Dairy Production Award Committee of the American Dairy Science Association, whose function it is to select the person to receive the Borden Award in the field of dairy production, has unanimously chosen Dr. William E. Krauss, of the Ohio Agricultural Experiment Station at Wooster, Ohio, for this honor on account of his important and able investigations in this field.

It was no small task for the members of the Award Committee to select the person to receive this award from the several who had been recommended for our consideration by the Nominating Committee or who had been proposed to us directly by other members of our Association. This was because several men had been suggested who had done important research work of a high grade in the field of dairy production.

Each member of the Award Committee considered, entirely independently, the information available concerning each person who had been nominated, including his research publications. Without any knowledge

WILLIAM E. KRAUSS

of how the other members of the Committee had ranked the nominees, each of us arrived at a definite ranking. Fortunately, when we compared by correspondence our decisions, we found that we had each placed Doctor Krauss in first rank.

We selected Doctor Krauss for this honor primarily because of the extensive investigations in which he has been the leader, upon the nutritive value of milk and upon factors affecting its quality and value. Doctor Krauss has not only obtained in these researches much information which is of great importance to the dairy industry, but he has also carried this information to the dairy industry by means of publications of a popular nature and addresses before various dairy organizations.

Among the important investigations by Doctor Krauss in this field are the following: The comparisons of various methods of increasing the vitamin D potency of milk, including studies of the cost with various methods. Extensive studies on the effects of pasteurization on the nutritive properties of milk in which it was concluded that "The nutritive deficiences of pasteurized milk (vitamin B and C) can be readily overcome by proper dietary control, and the continued use of pasteurized milk offers no serious problem from the food standpoint." Investigations of the effect produced upon the carotene content and other biological properties of milk, by feeding legume and grass silage.

Due consideration was also given to the joint investigations conducted in the field of dairy production by Doctor Krauss and his colleagues—Professors Hayden, Sutton, Bethke, Monroe and Perkins. These have included the extensive studies on the vitamin A and carotene content of the butterfat produced by various breeds of cows, on the use in dairy rations of fish meal and products containing fish meal, on methods of raising dairy calves on dry calf meals, and on such practical management problems as box stalls vs. tie and stanchion stalls for milk cows.

On account of the services of Doctor Krauss to the dairy industry in these several investigations, the Award Committee takes pleasure in presenting him to Mr. Wentworth, of The Borden Company, to receive the Borden Award in Dairy Production for 1938.

H. B. ELLENBERGER
C. W. LARSON
F. B. MORRISON, *Chairman*

"Mr. Wentworth, it is with pleasure that I present to you Dr. W. E. Krauss, the recipient of the Dairy Production Award."

Mr. Wentworth then spoke, "On behalf of The Borden Company and with a feeling of personal pride because of my acquaintance with you, I wish to present you with this much deserved award for the work you have done in scientific research.

"Like I did in the preceding presentation, I should like to read to you and for the benefit of those gathered, the inscription on the reverse side of the medal:

> Award for Outstanding Achievement in Dairy Production Research to *Dr. William E. Krauss, 1938,* by Direction of American Dairy Science Association.

"What I said in the previous presentation regarding the recognition of its recipient and the hope which The Borden Company has that it will stimulate further research and progress in this industry, applies equally in your case.

"The Borden Company congratulates you on the success you have attained and I add my own best wishes."

The presentation of Awards was completed at 9:00 P. M., and the rest of the evening was given over to visiting, card playing and dancing.

GENERAL PROGRAM

Ohio Agricultural Experiment Station
Wooster, Ohio, June 17, 1938

Mr. C. C. Hayden introduced Vice-Pres. Weaver at 10:45 A. M., as chairman of the morning's program. Director Edmund Secrest of the Ohio Agricultural Experiment Station was then introduced and gave an address of welcome. The program was followed as scheduled by the program committee except that in the absence of Dean Anthony, Mr. Balser read his paper.

Chief O. E. Reed of the Bureau of Dairy Industry was called upon and gave a very short and interesting message regarding the benefits one may derive by attending these meetings.

There were 154 in attendance.

After lunch was served a visit was made to observe the herd, farm and laboratories.

VOLUME XXI AUGUST, 1938 NUMBER 8

JOURNAL OF DAIRY SCIENCE

Published by the
AMERICAN DAIRY SCIENCE ASSOCIATION
R. B. STOLTZ
Ohio State University, Columbus, Ohio, Sec.-Treas.

ABSTRACTS OF LITERATURE

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Geneva, New York

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Published in cooperation with
INTERNATIONAL ASSOCIATION OF ICE CREAM MANUFACTURERS
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CONTENTS

Bacteriology
Breeding
Butter
Cheese
Chemistry
Concentrated and dry milk; by-products
Diseases
Feeds and feeding
Food value of dairy products
Herd management
Ice cream
Milk
Miscellaneous
Physiology

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Knight, D.
Krauss, W. E.

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Locke, R. B.
Lucas, P. S.
Lush, J. L.

Mack, M. J.
Macy, H.
Mann, A. I.
Marquardt, J. C.
Martin, W. H.
Maynard, L. A.
Mead, S. W.
Moore, L. A.
Morris, A. J.
Mueller, W. S.

Nair, J. H.
Nelson, D. H.
Nelson, J. A.

Overman, O. R.
Palmer, C. C.
Parfitt, E. H.
Petersen, W. E.
Price, W. V.

Reid, W. H. E.
Richardson, G. A.
Riddell, W. H.

Schultz, E. N.
Sommer, H. H.
Stark, C. N.
Swope, W. D.

Tarassuk, N. P.
Theophilus, D. R.
Thomsen, L. C.
Thurston, L. M.
Totman, C. C.
Trout, G. M.
Tuckey, S. L.

Webb, B.
Weckel, K. G.
White, G. C.
Wilbur, J. W.
Wilster, G.
Wylie, C. E.

Yale, M. W.

JOURNALS

American Creamery and Poultry Produce Review
American Journal of Diseases of Children
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Archives of Pediatrics

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Endocrinology

Food Industries
Food Manufacture
Food Research

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Ice and Refrigeration
Ice Cream Field
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Ice Cream Review
Ice Cream Trade Journal
Industrial and Engineering Chemistry

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Journal of Nutrition
Journal of Pathology and Bacteriology
Journal of Physical Chemistry
Journal of Physiology

Kaeseindustrie
Kolloid-Zeitschrift

Lancet
Le Lait

Milchwirtschaftliche Forschungen
Milchwirtschaftliche Zeitung
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SPECIAL PUBLICATIONS

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International Association of Milk Dealers

National Institute for Research in Dairying, Reading, England
New York Association of Dairy and Milk Inspectors

Prussian Dairy Research Institute, Kiel, Germany

State Agricultural Colleges and Experiment Stations

The Royal Technical College, Copenhagen, Denmark

United States Department of Agriculture

ABSTRACTS OF LITERATURE

BACTERIOLOGY

315. Standard Agar Counts as Compared with Counts on Improved Agars at 32° C. M. W. YALE, N. Y. Agr. Exp. Sta., Geneva, N. Y. Am. J. Pub. Health *28*, 2, p. 148, 1938.

Data collected by 56 laboratories showing comparative agar plate counts of 23,715 samples of dairy products are summarized. The advantages to be gained through the use of an improved agar and an improved incubation temperature are discussed. M.W.Y.

316. Disintegration of Paper Board for Bacteriological Examination. J. R. SANBORN, N. Y. Agr. Exp. Sta., Geneva, N. Y. Am. J. Pub. Health *28*, 5, p. 576, 1938.

The technic used for the disintegration of paper board for determination of total bacterial counts is described. The apparatus consists of an electrically operated food mixer with double propellors which exert a beating action on the fibers. The paper is reconverted to a uniform pulp suspension suitable for distribution in ordinary Petri plates. The technic has been used in connection with studies of paper milk containers. M.W.Y.

317. Suitable Paper Wrappers and Containers for Foods. J. R. SANBORN, N. Y. Agr. Exp. Sta., Geneva, N. Y. Am. J. Pub. Health *28*, 5, p. 571, 1938.

The sanitary control of paper milk containers and paper containers for foods in general is discussed. Topics included are (1) fundamental requirements for the production of paper of satisfactory sanitary quality; (2) types of microorganisms in container board; (3) bacterial counts of container board; (4) sanitary standards for container board; (5) handling of clean wrappers and container board and (6) examination of fabricated paper containers for milk. M.W.Y.

318. Microbial Flora of Paper Containers. FRED W. TANNER, Laboratories of Bact. of Univ. of Ill., and American Can Co., Maywood, Ill. Am. J. Pub. Health *28*, 5, p. 587, 1938.

The author concludes that the average bacterial content of paper milk containers for distribution of fluid milk is much lower than the counts which have been reported for some glass bottles. The types of bacteria are usually sarcinae, white staphylocci, aerobic sporeforming rods, and non-spore forming rods. Such organisms are of no sanitary significance according to the author. M.W.Y.

319. Contribution to the Study of Lactic Bacteriotherapie. Lactic Ferments and Fermented Milks. ALEXANDER NEUKOMM, Nestle and Anglo-Swiss Condensed Milk Co., Vevey, Switzerland. Le Lait *18*, 174, p. 353, April, 1938.

The various organisms present in the cultures used in preparing such milks as Yoghourt, Koumiss, and others are described and the possible mechanism of lactic acid formation is discussed. The chemical composition of these milks is also reported. Forty literature citations are given.

A.H.J.

BREEDING

320. A Statistical Inquiry into the Inheritance of Milk Yield in Three Herds of Dairy Shorthorn Cattle. A. D. BUCHANAN SMITH. Jour. of Dairy Research *8*, 347–388. 1937.

The paper embodies an examination of the possibility of sex-linked genes affecting the transmission of milk yield. To reduce environmental effect the study was restricted to three herds of the English Dairy Shorthorn breed. Fisher's squared difference method was used. The lumped results indicate that the paternal grandsire has a lesser effect than the maternal grandsire. In this respect the figures for one herd did not agree with the other two. The subject is reviewed, and the author concludes that the accuracy of the conclusions which may be drawn from statistical studies of this type are not commensurate with the labor involved. S.T.C.

BUTTER

321. Use of Anti-oxidants to Prevent Tallowiness in Butter. W. J. CORBETT AND P. H. TRACY, Univ. of Ill., Urbana, Ill. Nat. Butter and Cheese J. *28*, 24, p. 10, Dec. 25, 1937.

The addition of 1 per cent Avenex (finely powdered oat flour) on a fat basis retards the development of oxidized flavors in butter. The addition of an aqueous filtrate of Avenex appears to be the most practical procedure of adding it to the cream. Avenex should be added to the cream after neutralization and before pasteurization. The addition of Avenol (an extract of oat flour with an oil solvent hexane) gave less positive results than did the Avenex. Wrapping prints in Avenized parchment (made by sizing parchment paper in oat flour solution) retards the development of surface flavors and improves slightly the keeping quality of the butter.

W.V.P.

322. What Needs to be Done to Increase the Consumption of Butter? L. C. THOMSEN, Univ. of Wisconsin, Madison, Wis. Nat. Butter and Cheese J. *29*, 2, p. 10, Jan. 25, 1938.

There is an apparent drop in butter consumption probably because people regard butter as fattening and expensive. Consumption may decrease still more with the declining proportion of children in the population and the increased advertising of butter substitutes. Butter advertising should stress that educators and doctors favor the use of butter. The adult population must be honestly convinced that butter is not expensive considering calorie and vitamin content and that when it is used intelligently it is not fattening. Improving the condition of milk production, methods of manufacture, flavor and color control should make advertising campaigns more effective. W.V.P.

323. Making No. 1 Butter from No. 2 Cream. L. P. SHARPLES, Milk Processes Inc., Philadelphia, Pa. Nat. Butter and Cheese J. *29*, 6, p. 7, Mar. 25, 1938.

"Plastic cream" is chilled cream with 80 to 83 per cent of butterfat. Compared to fluid cream it is cheaper to ship and store. It is made by passing heated fluid cream through a special centrifugal separator which removes curd, dirt (if the cream is neutralized), and nine-tenths of skimmilk. The bowl of the centrifuge is automatically self-cleaning. The cream is pasteurized after coming from the centrifuge and is passed over a special stainless steel drum cooler. There is no extra cost for making plastic cream when cream for storage is produced from whole milk. When fluid cream is received instead of whole milk the extra cost is estimated as one-eighth cent per pound. Plastic cream is used for making fluid cream, ice cream, cream cheese, flavored spreads and butter. W.V.P.

324. Technological Exploration of the Art of Buttermaking. M. E. PARKER, American Butter Inst., Chicago, Ill. Food Research *3*, 1 and 2, p. 261, Jan.–Feb., Mar.–Apr., 1938.

An interesting discussion is given of the keeping qualities of butter and some problems of manufacture. F.J.D.

325. The Determination of the Quantity of Diacetyl in Butter. R. DEHOVE AND L. DESSIRIER, Municipal Lab. of Lille, France. Le Lait *18*, 172, p. 150, Feb., 1938.

The usual methods of determining diacetyl based on the formation of dimethylglyoxime or of quinoxaline, or of xyloquinone were tested on 50 gram samples of butter but were not found sensitive enough for determining the diacetyl in this small quantity of butter. The dimethylglyoxime method was accordingly modified. Twenty cc. of distillate obtained from the 50 grams of butter were treated with 1 cc. of 10 per cent chlorhydrate of hydroxyamine followed by 2 cc. of normal soda solution. After agitation 1 cc.

of a 0.2 per cent solution of nickel sulphate was added and then 0.6 cc. of normal acetic acid. The whole solution was then transferred to a porcelain dish and evaporated on a water bath. The residue was taken up 3 times with 2 cc. of chloroform, the filtrate and washings were evaporated to dryness on a small white porcelain dish. The nickel dimethylglyoximate then deposited as a reddish violet coloration on the white porcelain. The quantity of diacetyl in the sample was then determined by comparison with the colors in test dishes prepared in the same manner from quantities of diacetyl varying from 0.05 milligram to 0.50 milligram corresponding to diacetyl contents of the butter varying from 1 to 10 milligrams per kilogram. Another method of determining diacetyl was also investigated depending on the intense color produced in sulphuric acid medium by pyrocatechol and resorcin in the presence of traces of diacetyl. A.H.J.

Other abstracts of interest are numbers 316, 317, 318, 344, 345, 351, 368, 369, and 371.

CHEESE

326. Buttermilk and Cottage Cheese. C. R. Nickolls, H. P. Hood and Sons, Inc., Boston, Mass. Ann. Conv. Intern. Assoc. Milk Dealers, Plant Section, p. 11, 1937.

For cultured buttermilk pasteurization of skimmilk at 180°F. or more for 20 to 30 minutes is recommended. A system of carrying starters and three methods of producing butter granules are proposed. Little agitation and storage temperatures below 50°F. are emphasized.

In order to control texture and flavor of cottage cheese more accurately extracts or coagulators are recommended and the setting period is confined to 12 hours. The curd is cut just before wheying off occurs at near .8 per cent acidity. Stirring only every 15 or 20 minutes and other details in order to produce best results are specified. E.F.G.

327. Natural Cheese with Package Appeal. Anonymous. Nat. Butter and Cheese J. *29*, 1, p. 14, Jan. 10, 1937.

The mechanical method of making and packaging a soft-ripened type of cheese is described. Pasteurized-milk curd is formed into long slabs of uniform size and weight. These are cut into small loaves or bricks after curing. The treatment permits ripening with minimum rind development; reduces the cost of manufacture; and makes the cheese more attractive to the distributor and consumer. Patents for the special equipment have been granted to Raymond Miollis, Natural Cheese Inc., Chicago, Illinois.

W.V.P.

328. A Quality Improvement Program Proposed for the Wisconsin Cheese Industry. W. V. PRICE, Univ. of Wisconsin, Madison. Nat. Butter and Cheese J. *29*, 6, p. 18, Mar. 25, 1938.

A plan is suggested to secure compensation for the voluntary production of an approved or "certified" type of American cheese. Standards of production, manufacture and handling would be defined by an elected "Council" of industry members representing farmers, manufacturers and dealers. The cooperation of interested public health agencies would be invited in formulating these definitions. The Council would determine suitable compensation to producers for meeting these standards and would control the necessary inspection, branding and analytical services which would be paid for by participating factories. Costs of these services are estimated at approximately 0.2 cents per pound of approved cheese.

W.V.P.

329. Canning of Cheddar Cheese. L. A. ROGERS, Bureau Dairy Industry, U. S. Dept. of Agr., Washington, D. C. Food Research *3*, 1 and 2, p. 267, Jan.–Feb., Mar.–Apr., 1938.

The development of canned cheddar cheese is discussed together with its present status and future possibilities. F.J.D.

330. Utilization of Whey in Foods. B. H. WEBB, Bureau Dairy Industry, U. S. Dept. Agr., Washington, D. C. Food Research *3*, 1 and 2, p. 233, Jan.–Feb., Mar.–Apr., 1938.

The author discusses the work of the B. D. I. in attempting to find uses for cheese factory whey. Some success has been experienced in utilizing whey in certain cream soups, tomato juice, fruit mixtures and drinks and fruit whips. Sweetened condensed whey appears to offer interesting possibilities. F.J.D.

331. The Identification of Roquefort Cheese. G. GENIN, Paris, France. Le Lait *18*, 174, p. 372, April, 1938.

Genuine Roquefort cheese is made entirely from sheep's milk. Sheep's milk fat is characterized by a considerably higher caprylic and capric acid content. On the analysis of the fat this appears as a higher Polenske number. The higher Polenske number of the fat from cheese of the Roquefort type consequently indicates whether it has been made from cow's or from sheep's milk. Cheese fat having a Polenske number of 3 or lower indicates the cheese was not made from sheep's milk. The fat used in determining the Polenske number may be extracted with ether or allowed to drain from a warmed sample that has been well worked to soften it. The feed given the cows or sheep does not cause the difference in Polenske numbers of fats

from the two milks as even when cows and sheep receive the same feed there is the characteristic difference in Polenske numbers of the fats from the two milks. A.H.J.

Other abstracts of interest are numbers 351, 368, and 369.

CHEMISTRY

332. Action of Enzymes at Low Temperatures. A. K. Bells and Hans Lineweaver, U. S. Dept. of Agr., Washington, D. C. Food Research *3*, 1 and 2, p. 57, Jan.–Feb., Mar.–Apr., 1938.

The authors conclude that enzyme action at low temperatures not only takes place but is an important factor in food preservation. The velocity of reaction in some cases, especially with lipase, is surprising. In others it is so slight as to be detected with uncertainty. However, even in the latter cases the initial phase of the reaction may have been completed so that when the food is brought to ordinary temperatures again the spoilage occurs with greater rapidity. F.J.D.

CONCENTRATED AND DRY MILK; BY-PRODUCTS

333. Advancement in Sterilization Methods for Canned Foods. C. O. Ball, American Can Co., Maywood, Ill. Food Research *3*, 1 and 2, p. 13, Jan.–Feb., Mar.–Apr., 1938.

The author presents a very complete historical review of the subject with bibliography, and list of patents, some of which deals with evaporated milk or with methods which might be applicable to evaporated milk, particularly "high-short sterilization" methods. F.J.D.

334. Distinctive Characteristics of Skimmilk Powders (Powders Soluble —Powders by the Hatmaker Process). Jean Pien, Lab. of the Farmers Union, Paris, France. Le Lait *18*, 174, 347, April, 1938.

Finely ground skimmilk powders prepared by the Hatmaker process have the same appearance as the more soluble powders made by the spray process. They may be distinguished, however, by their appearance under the microscope. Skimmilk powder, made by the Hatmaker process, consists of irregularly shaped plates, while spray powder is made up of spheres. When the two types of powder have been mixed, microscopic examination serves to detect such mixture. Spray powders are considerably more soluble than powders made by the Hatmaker process. When 10 grams of the latter powder is mixed with 100 cc. of water and allowed to stand, the precipitate will occupy 50 to 90 cc. Spray process powders similarly tested will show a precipitate of only 1 cc. or less. Skimmilk powders made by the Hatmaker

process are lower in bacterial count than spray skimmilk powders. The reduction time for methylene blue is accordingly much longer for the Hatmaker type of skimmilk powder. Reconstituted spray skimmilk powder sours after standing for a short time, while reconstituted Hatmaker powder may stand for several days without souring. A.H.J.

335. Artificial Wool from Casein. P. DIATCHENKO. Le Lait *18*, 175, p. 233, March, 1938.

The properties of casein of importance for its use in the making of synthetic wool are: the moisture content because of its effect on the stability in connection with subsequent dyeing, the fat content because of its effect on the quality of the textile fibers and on filtering the casein solution before casting the threads, the ash content because of the effect on the viscosity of the casein solution, and on the quality of the fibers, and the acidity because high acidities of the casein produce transformations in the properties of casein. The process of making synthetic wool involves the following steps—preparation of a casein solution, preparation of the fiber, construction of the thread, fixation of the thread and drying and finishing of the thread. Casein is usually dissolved according to 2 procedures—by ammonium hydroxide or by caustic soda plus carbon disulphide. The solutions produced by the two methods are filtered through cotton and then pass to machines where, under pressure, they are forced through small openings into the fixing solution containing acid and other compounds including formalin. After washing and drying, the fibers prepared in this manner have the appearance and feeling of wool. The synthetic wool prepared by the ammonia method is of greater fineness than natural wool or synthetic wools prepared by the carbon disulphid method or the Italian method. The resistance to pull and the extensibility of the synthetic wool prepared by the ammonia process approach more closely these properties of natural wool than do the synthetic wools prepared by the carbon disulphide method or by Italian Lanatal. A.H.J.

Other abstracts of interest are numbers 315, 336, 337, 342, 344, 345, 351, 368, and 369.

DISEASES

336. The Effect of Mastitis on the Udder and Its Product. T. S. SUTTON, Ohio State University, Columbus, Ohio. Ann. Conv. Intern. Assoc. Milk Dealers, Prod. Section, p. 3, 1937.

The causal organisms and changes in the udder during the progress of the disease are outlined. Changes in the milk may be classified as physical, chemical and biological. The physical changes are those of consistency and

color or appearance. Chemically, mastitis milk usually shows an increase in chlorides, catalase, albumin, and pH, and a decrease in lactose and casein. The biological changes usually noted are increases in leucocytes and bacteria, the bacteria being chiefly long chain Streptococci. E.F.G.

337. The Composition of Milk as Affected by Mastitis. C. H. WHITNAH, W. J. CAULFIELD, A. C. FAY, AND V. D. FOLTZ, Kansas Agr. Exp. Sta., Manhattan, Kansas. Ann. Conv. Intern. Assoc. Milk Dealers, Prod. Section, p. 19, 1937.

A numerical mastitis milk score is obtained based upon leucocyte and bacteria counts. These were compared with chemical determinations of minerals, sugar, protein, lecithin, lipase, phosphatase, carotene, flavin, and vitamin C, on 50 to 70 cows for a period of two years. The data confirm and extend to additional constituents the conclusion of other workers, that latent mastitis does not produce uniform serious changes in the composition of milk. E.F.G.

338. A Study of the Vaginal Content of Pregnant Bang-Infected Cows for the Presence of Brucella abortus. C. P. FITCH, W. L. BOYD, AND LUCILLE M. BISHOP, University of Minnesota, St. Paul, Minnesota. J. Am. Vet. Med. Assoc., N. S. *45*, 2, p. 171, Feb., 1938.

Examinations of swabs taken from the vagina of 58 reacting animals, indicate that *Brucella abortus* is not ordinarily found in the vagina of pregnant, Bang-infected cows until very shortly before an abortion or a normal parturition.

However, the organism appears in the discharges after the seal of pregnancy is broken. The investigators cautioned that the animals examined did not show noticeable discharges from the vagina and that animals showing such discharges might be exceptions. J.W.W.

339. Bang's Disease—Status of Vaccination. W. WISNICKY, Wis. Dept. of Agr. and Markets, Madison, Wis. Ann. Conv. Intern. Assoc. Milk Dealers, Prod. Section, p. 72, 1937.

About 20 per cent of abortions in cattle are produced by causes other than infection with the Bang organism. In recent years it has been proved that the abortion bacterins are practically worthless in the control and treatment of Bang's disease. The virulent live culture vaccines do have some merit. However, they possess disadvantages which more than outweigh any good that they may have. In the use of the virulent live culture vaccine, the disease was actually introduced into herds that were free from the disease. More recent researches indicate that by the use of a moderately virulent strain of the Bang organism on young calves, a degree of immunity against the disease may be established. E.F.G.

340. Bang's Disease in Cattle. A. E. Wight and J. M. Buck, U. S. Dept. of Agr., Beltsville, Md. Ann. Conv. Intern. Assoc. Milk Dealers, p. 60, 1937.

Since July, 1934, when Federal funds were made available for conducting supervisory work in the field and making payments to owners whose cattle reacted to the test, steady progress has been made until at present 15.3 per cent of the cows of the United States are under supervision. During the fiscal year ended June 30, 1937, agglutination tests were applied to 8,000,000 cattle with 398,000 or 5 per cent reacting. The history of attempts to control the disease with vaccines and similar means is traced. Some success with calfhood vaccination under carefully controlled conditions with a vaccine from *Br. abortis* strain 19 has been attained under experimental conditions. E.F.G.

341. Pathological Changes Occurring in the Bovine Udder Due to Infectious Mastitis. W. T. Miller, Bureau of Animal Industry, Beltsville, Md. Ann. Conv. Intern. Assoc. Milk Dealers, Prod. Section, p. 5, 1937.

This study is restricted to the effects of cocci entering the udder through the teat canal. Examination of 304 udders showed 256 or 84 per cent were carrying streptococci in one or more quarters so that the study was largely one of lesions occurring in chronic streptococcus mastitis. The normal course of this infection was an infiltration of leucocytes followed by the formation of increasing quantities of connective and scar tissue with the ultimate almost complete disappearance of normal alveoli in longstanding cases of marked mastitis. The various conditions are illustrated with ten photomicrographs. E.F.G.

FOOD VALUE OF DAIRY PRODUCTS

342. The Nutritive Value of Milk Supplemented with Minerals as an Exclusive Diet for Rats. Comparison of Equal Volumes of Summer and "Winter" Milk Before and After Laboratory Pasteurization. K. M. Henry, E. W. Ikin, and S. K. Kon. J. Dairy Research *8*, p. 282, 1937.

Milk was obtained simultaneously from cows on early pasture and from stall-fed cows receiving winter rations. By suitable blending of the morning's and evening's milkings of each milk the fat content of the two milks was equalized daily. A part of each milk was then pasteurized in the laboratory by a "holder" method. The total nutritive value of the milk was measured on rats in two separate experiments. In one the milks, supplemented with iron, copper and manganese, were fed as an exclusive diet.

The four types of milk were given to twelve groups of litter-mate male rats, the intake being equalized within each group. The experiment lasted 8 weeks, and at the end no difference was found in gain in weight, body length, general appearance of the rats or composition of the carcasses. The palatability of the milks as gauged by the refusals of the rats were investigated by various statistical methods, which showed that summer milk was probably more palatable than "winter" milk, but that pasteurization had no effect.

In the second experiment the intake of milk was limited to 20 ml. daily, but the rats were given in addition unlimited access to a basal diet of casein, sugar and salts. This experiment was also carried out on groups of four litter mates (four groups of does and seven groups of bucks). After 8 weeks 5 per cent brewer's yeast was added to the basal diet, resulting in a marked increase of the growth rate of all the groups. At the end of 8 weeks, the gains in weight, intake of basal diet, and gains per gram of solids ingested were compared. The only statistically significant differences were in favor of pasteurized summer milk when compared with summer raw and with "winter" pasteurized.

Taking both experiments into consideration it is concluded that they did not reveal any difference in the total nutritive value of the milks. S.T.C.

343. Carotene and Ascorbic Acid Content of Fresh Market and Commercially Frozen Fruits and Vegetables. G. A. FITZGERALD, Birds Eye Labs., Boston, Mass., AND C. R. FELLERS, Mass. Agr. Exp. Sta., Amherst, Mass. Food Research *3*, 1 and 2, p. 109, Jan.–Feb., Mar.–Apr., 1938.

Data showing that the vitamin content varies considerably between different fruits and vegetables and between the same ones grown or packed in different places. Vitamin A is almost totally retained during processing and freezing and also during storage. F.J.D.

344. The Nutritive and Safety Value of Pasteurized Milk. GORDON BATES, Health League of Canada, Toronto, Canada. Ann. Conv. Intern. Assoc. Milk Dealers, General Sessions, p. 11, 1937.

Experience of Toronto from health standpoint, where compulsory pasteurization has been in effect since 1915, is cited to indicate the effectiveness of pasteurization since not a single case of bovine tuberculosis infection has been encountered in this generation of children raised on pasteurized milk in Toronto. Also, among 100,000 children admitted to the hospital for sick children there has not been a single case of abdominal tuberculosis since inauguration of pasteurization. The progress of pasteurization in Canada and United States is discussed.

Evidence is given to indicate that the nutritive properties of milk are

not injured by pasteurization, and the author recommends that all milk be pasteurized. E.F.G.

345. The Status of Vitamin A as Related to Dairy Cattle. O. C. Copeland, Texas Agr. Exp. Sta., College Station, Texas. Ann. Conv. Intern. Assoc. Milk Dealers, Prod. Section, p. 28, 1937.

Effects of vitamin A deficiency in feed upon vitamin A content of resulting butter are shown. Cows fed on cottonseed meal and hulls produced fat with 2½ units vitamin A potency per gram. With the above, plus sorghum silage, 12 per gram, whereas with pasture also added the butterfat contained 33 units per gram. On a vitamin A deficient diet, the most rapid decrease in potency of butterfat occurs during the first 60 days. Two cows fed a vitamin A deficient ration decreased from 40 units to 12 units per gram, but on 5 hours pasture daily came back to original 40 units at end of third day. It seems that green pasture is necessary for the production of butterfat which can be classed as high in vitamin A potency. Cows in such an advanced stage of vitamin A deficiency that they cannot gain their feet, recover rapidly when vitamin A is administered. E.F.G.

HERD MANAGEMENT

346. Die Bestimmung der Milchleistungsfähigkeit. (Measuring milk producing ability. Part 2.) L. Krüger. Züchtungskunde *13*(2), 49–63. February, 1938.

The average discrepancy between a cow's uncorrected record and her real producing ability is about 20 per cent of the record in data from cow testing associations in Silesia. In about one-fourth of the cases the discrepancy exceeds 40 per cent. Various methods of making these discrepancies smaller so that they will be less serious obstacles to successful selections are compared. It is not very practical to avoid all corrections by (1) absolute standardization of conditions beforehand, or (2) by providing physiologically optimum conditions for one or more "test" lactations, or (3) by selecting afterward those lactations made under conditions which happened to be "standard." Those procedures are sometimes helpful but often reduce the errors only a little and can rarely include more than about a quarter of all records, even when the range of conditions included as "standard" is made wider than is desirable. The use of correction factors (as for age, service period, lactation length, etc.) helps but is never complete and does not adjust for general conditions of feeding or management to which all cows of the herd are exposed. The method recommended is to correct the lactations to the production at a standard age during a calving interval of definite length (360 days) and with a dry period and preceding dry period of definite length, by means of suitable correction factors. Then this standard-

ized record is corrected for general conditions of feeding and management by comparing it with the production of other cows freshening near the same time in the same herd. It is claimed that the average discrepancy between a record corrected by Krüger's method and the cow's real ability is only about 9 per cent. J.L.L.

ICE CREAM

347. "Maple—Favorite Food Flavor." FREDERICK S. MORISON. Food Ind. *10*, 3, p. 143, 1938.

This article is a discussion of the grades and uses of maple syrup. A concentrated syrup about two and one-half times the strength of ordinary maple syrup is now available which yields maximum flavor with minimum amount of sweetening. E.O.A.

348. Sound Waves—A New Tool for Food Manufacturers. L. A. CHAMBERS. Food Ind. *10*, 3, p. 133, 1938.

A general discussion is presented of the theories regarding dispersion of particles by the sonic vibrator and the uses of the equipment in the milk and ice cream plant. E.O.A.

349. Sodium Alginate as a Stabilizer. MERRILL J. MACK. Food Ind. *10*, 4, p. 195, 1938.

This article is a digest of the practical application of sodium alginate as a stabilizer in ice cream, market cream, sour cream, sweet cream, cheese spreads, chocolate milk and ices and sherbets. E.O.A.

Other abstracts of interest are numbers 315, 316, 317, 318, 321, 332, 334, 342, 343, 344, 345, 351, 355, 356, 359, 364, 368, 369, 370, and 371.

MILK

350. Why Confusion in the Milk Industry? F. J. BAHL, Mathews Frechtling Dairy Co., Cincinnati, Ohio. Milk Dealer *27*, 7, p. 40, 90, April, 1938.

The author points out that the fresh milk industry can no longer ignore canned milk as its competition. Canned, evaporated milk is here to stay, and the idea of pegging fluid milk prices according to the whim and fancies of any particular group is no longer possible.

The production of fluid milk does not vary importantly from the production of milk for evaporating purposes; and the idea of pegging fluid milk market continually and having its competitor, evaporated milk, buy on a formula basis is not logical. If it is logical, possible and practical to buy

milk for evaporating on a formula basis, a ratio can be established for fresh milk. It is time that this matter is presented to the government and other interested parties in a decisive way. No man can afford to ignore his competition any longer—either in the buying end or in the sales end.

A definite fixed ratio of one cent a quart more to a producer for producing fresh milk is suggested. C.J.B.

351. Cause of Black Spots in Milk Cans. (ANONYMOUS.) Milk Dealer *27*, 7, p. 42, April, 1938.

Report of an investigation showing that black spots in milk cans are frequently caused by leaving a stirrer of pure nickel in the can of milk.

The explanation given is that the black spots were caused by electrolytic action set up by the contact of two different metals; the lactic acid in the milk, slight as it was, setting up a condition similar to that found in a wet battery, the resulting electrolysis causing oxidation of the tin in the form of black spots, all with that characteristic jagged, uneven formation.

C.J.B.

352. Individual Tumblers of Milk for Restaurant Trade. (ANONYMOUS.) Milk Dealer *27*, 7, p. 43, April, 1938.

A description is given of how the Harding Restaurants in Chicago are serving pasteurized, homogenized milk in individual tumblers which the waiters open before the customers. C.J.B.

353. Improving the Quality of Milk. A. A. BORLAND, Penn. State College, State College, Pa. Milk Dealer *27*, p. 62, April, 1938.

A discussion on improving the quality of milk in which the author deals with flavor, cooling milk at the farm, cleaning utensils, color and vitamins in milk, inspection at the intake, and paying a bonus for premium milk.

C.J.B.

354. Daylight vs. Night Delivery. F. E. ROGERS, Thompson's Dairy, Washington, D. C. Milk Dealer *27*, 7, p. 56, April, 1938.

A discussion of the advantages, disadvantages, and consumer reaction to daylight delivery. The author sums the pros and cons of the subject by saying that daylight delivery has the preponderance of theoretical advantages. Practically, however, there are some very potent disadvantages to a widespread adoption of daylight service universally. C.J.B.

355. The Phosphatase Test as a Means of Determining Efficiency of Milk Pasteurization. HOMER L. SPENCER, City Health Dept., Tulsa. Milk Dealer *27*, 6, p. 66, March, 1938.

A description of the principles upon which the phosphatase test is based. Modifications of the original test are also given. The author concludes that it can be stated that although this test is probably not perfect in its present form, and that it may be modified from time to time as experience dictates and as needs for new application arise, the phosphatase test as devised by Kay and Graham offers the most accurate and sensitive means for determining the efficiency of pasteurization at present available. C.J.B.

356. Present Status of Phosphatase Test for Pasteurization. WALTER VON DOHLEN TIEDEMAN, State Dept. of Health, Albany, N. Y. Am. J. Pub. Health *28*, 3, p. 316, 1938.

The author believes that the phosphatase test for pasteurization has great practical value and reviews typical examples of violations that were found by the use of this test. Its great value to the milk control official is discussed by Paul F. Krueger, Director, Bureau of Dairy Products, Board of Health, Chicago, Illinois, and by Sol Pincus, Deputy Commissioner, Department of Health, New York, N. Y. M.W.Y.

357. Application of Scientific Control in the Bottling Industry. MAX LEVINE, Dept. of Bact., Iowa State College, Ames, Iowa. Food Research *3*, 1 and 2, p. 141, Jan.–Feb., Mar.–Apr., 1938.

The problems of the bottling industry are discussed. The concentrations of sodium hydroxide in bottle washing with relation to thermal period to destroy bacteria are given. These data are applicable in the washing of milk bottles.

° F.	Per cent NaOH				
	1.0	1.5	2.0	2.5	3.0
	Time to kill (minutes)				
110	432.0	209.0	125.0	83.8	60.4
120	210.0	102.0	60.8	40.7	29.4
130	103.0	49.5	29.6	19.8	14.3
140	49.8	24.1	14.4	9.7	7.0
150	24.2	11.7	7.0	4.7	3.4
160	11.8	5.7	3.4	2.3	1.6
170	5.7	2.8	1.7	1.1	0.8
180	2.8	1.3	0.8	0.5	0.4

F.J.D.

358. Some Recent Advances in Dairy Technology. J. A. TOBEY, American Inst. of Baking, New York. Food Research *3*, 1 and 2, p. 211, Jan.–Feb., Mar.–Apr., 1938.

The author discusses in a general non-technical manner the advances in

the dairy industry over the last 100 years, stressing particularly pasteurization, knowledge of nutrition, and irradiation. F.J.D.

359. Researches on the Pasteurization of Milks for Human Consumption. I. Choice of a Culture Medium for the Counting of Microorganisms. G. GUITTONNEAU, G. MOCQUOT, AND A. EYRARD, National Lab. of the Dairy Industry. Le Lait *18*, 173, p. 226, March, 1938.

It is stated as a general principle that a medium to be used in determining the bacterial content of milk should contain milk. Because of the opacity of media containing milk, the milk is subjected to a tryptic digestion for 3 days at 37°C (98.6°F.). Skimmilk treated in such a manner and diluted to 3 times its original volume constitutes a satisfactory media. The results obtained with pasteurized and raw milks were equivalent to those obtained when media containing small amounts of milk or lactose plus other sugars and peptones, *i.e.*, the media proposed by Bowers and Hucker and by Demeter. A.H.J.

360. Address of the President. R. C. FISHER, Intern. Assoc. Milk Dealers, Wellesley Farms Dairy, Wellesley Farms, Mass. Ann. Conv. Intern. Assoc. Milk Dealers, General Sessions, p. 11, 1937.

Progress of the organization and the milk industry during the past year is reviewed. Accomplishments of the following active committees are listed: Sanitary procedure, transportation, laboratory methods, simplified practice, accident prevention, public relations, and legislative. The service known as "The Balanced Job of Selling and Route Supervision" is explained. The aggressive policy of the Association with reference to public relations promoted under the auspices of the Milk Industry Foundation, is designed to pave the way for more effective sales promotion by the membership. National Milk Week has made a distinct contribution and offers possibilities for greater usefulness. E.F.G.

361. Buying Plans. Ratio Between Cream Fat and Whole Milk Prices. M. J. METZGER, Bowman Dairy Co., Chicago, Illinois. Ann. Conv. Intern. Assoc. Milk Dealers, Prod. Section, p. 34, 1937.

The use of the method by which a premium over the evaporated milk formula price based upon the butter and cheese market now used in Chicago, is discussed. E.F.G.

362. Uniformity of Dairy Score Card and Inspection. WALTER D. TIEDEMAN, N. Y. State Dept. of Health, Albany, N. Y. Ann. Conv. Intern. Assoc. Milk Dealers, Prod. Section, p. 40, 1937.

Overlapping milk sheds have created a situation where some dairy farms are under the inspection of as many as 9 inspectors and 8 different sets of regulations. Progress in elimination of conflicting regulations in New York State is reported; also some uniformity with New Jersey requirements. Further progress in uniformity must wait upon some interstate or government action. E.F.G.

363. Production Trends. JOHN B. SHEPARD, Sr. Agr. Statistician, U. S. Dept. of Agr., Washington, D. C. Ann. Conv. Intern. Assoc. Milk Dealers, Prod. Section, p. 47, 1937.

Over a 56 year period it appears that consumption has increased from around 750 pounds milk equivalent per person to 825 pounds or only about 10 per cent. Three things must be kept in mind. First, milk cows are beef and may be sold as beef. Second, milk cows are machines and may be slowed down or speeded up by price of feed. Third, many farmers will milk less when times are good and their time is worth more or more congenial labor is available. The fifteen year cattle cycle reached a low point in 1935. Possibly a larger proportion of the milk will, in the future, come from herds where machine methods can be used. E.F.G.

364. Plate Type Heat Exchangers. G. F. POPPENSIEK, Borden's Farm Prod., New York City. Ann. Conv. Intern. Assoc. Milk Dealers, Plant Section, p. 63, 1937.

The development of plate heat exchangers used in Europe since 1923 and introduced into the U. S. in 1927 is traced. The writer reports the method of installation, operation and results from 32 of these heaters replacing various internal and external cooling units and heaters of various sorts. Favorable results are reported due to high regenerative efficiency, ease of cleaning, economy of floor space, etc. E.F.G.

365. Necessary Changes in the Average Plant to Comply with U. S. Public Health Service Standards Ordinance and Code. PAUL F. KRUEGER, Board of Health, Chicago, Illinois. Ann. Conv. Intern. Assoc. Milk Dealers, Plant Section, p. 67, 1937.

A detailed discussion of the requirements of the ordinance with respect to buildings and floors, walls and ceilings, ventilation pipes and fittings, cleaning equipments and bottles and pasteurization. E.F.G.

366. Reports of Simplified Practice Committee. A. H. LUEDICKE, Ann. Conv. Intern. Assoc. Milk Dealers, Plant Section, p. 75, 1937.

Two new solderless fittings are announced. The American Society for Testing Materials has organized Committee C–14 on Glass and Glass Prod-

ucts and glass bottle problems are being presented to this committee. A change in standards for glass milk bottles and a reduction of tolerances on stainless tubing are being proposed. E.F.G.

367. Milk Machinery of the Future. JOHN FORSLEW, Bowman Dairy Co., Chicago, Illinois. Ann. Conv. Intern. Assoc. Milk Dealers, Plant Section, p. 3, 1937.

The present trends in pasteurizing equipment suggest the possible more extensive use of short time high temperature pasteurization and eventually means other than heat for the destruction of bacteria. Bottle washers might combine the advantages of hydraulic and soaker types and incorporate better bottle cooling and automatic bottle feed. Bottle fillers, milk containers, fittings, can washers, can dumpers, milk cans, can washers and refrigeration are discussed from standpoint of probable future developments. E.F.G.

Other abstracts of interest are numbers 315, 316, 317, 318, 319, 326, 332, 336, 337, 338, 339, 340, 341, 342, 344, 345, 368, 369, 370, and 371.

MISCELLANEOUS

368. What's New in Farm Science. Part I. 54th Ann. Report of Director, year ending June 30, 1937. Agr. Exp. Sta., Univ. of Wisconsin, Madison, Wis., Bull. 439, Dec., 1937.

This bulletin briefly summarizes findings of work newly completed or in progress. The following sections are of interest to the dairy industry:

"Grass juice factor" is a new vitamin. G. O. Kohler, C. A. Elvehjem, and E. B. Hart, p. 2.

Progress in study of vitamin B. C. A. Elvehjem, A. Arnold, and E. B. Hart, p. 4.

A new dietary factor in the vitamin B complex. D. V. Frost, C. A. Elvehjem, p. 5.

Pigs and calves need fat along with skimmilk. E. J. Schautz, C. A. Elvehjem, and E. B. Hart, p. 10.

Nitrogen compounds in livestock feeding. E. B. Hart, H. J. Deobald, and G. Bohstedt, p. 11.

Tests on A. I. V. silage and milk. W. H. Peterson, G. Bohstedt, E. B. Hart, *et al.*, p. 14.

Who operates Wisconsin milk plants? A. W. Colebank, R. K. Frokker, and A. C. Hoffman, p. 35.

Accuracy of tuberculin testing. E. G. Hastings and J. R. McCarter, p. 53.

Spoilage of cheese brines. G. B. Landerkin and W. C. Frazier, p. 60.

Studies on Swiss cheese starter cultures. H. J. Pepler, P. R. Elliker, and W. C. Frazier, p. 61.

Vitamin C, oxidized flavor and the test for copper in milk. J. P. Turgeon, V. C. Stebnitz, and H. H. Sommer, p. 63.

Studies on lipase activity. K. G. Weckel, H. C. Jackson, and D. W. Jones, p. 65.

Microscopic examination of cheese. H. Templeton, D. K. Stewart, and H. H. Sommer, p. 66.

Test for extraneous matter in cheese. D. W. Spicer and W. V. Price, p. 67.

Acidity control in Brick cheese. D. W. Spicer and W. V. Price, p. 68.

Design of milk irradiating equipment. H. H. Beck, H. C. Jackson and K. G. Weckel, p. 70.

Abnormal milk and mastitis. E. G. Hastings, p. 75.

Bang's disease. M. R. Irwin, L. C. Ferguson, B. A. Beach, and G. C. Humphrey, p. 77. W.V.P.

369. The Use of Metals in the Dairy Industry. I. Aluminum. G. GENIN, Paris, France. Le Lait *18*, 172, p. 113, Feb., 1938.

A review is given of the properties of aluminum as a material for the fabrication of dairy equipment and the behavior of aluminum in contact with dairy products. Among the phases of the subject discussed are: the historical development of metallic aluminum, aluminum alloys, methods of fabricating aluminum, commercial forms of aluminum, physical, chemical and mechanical properties of aluminum, superficial treatment of aluminum to allow painting, burnishing and polishing, the workability of aluminum, the corrosion of aluminum by milk, sterilizing solutions, brine and alkaline cleaning solutions. It is noted that many alkaline solutions are very corrosive to aluminum, but a solution containing 0.5 to 5.0 per cent sodium carbonate and 0.5 to 1.0 per cent of silicate of sodium has little corrosive effect. A.H.J.

370. The Cash Value of Safety. A. A. NICHOSON, The Texas Co., New York City. Ann. Conv. Intern. Assoc. Milk Dealers, General Sessions, p. 34, 1937.

Accident costs are divisible two ways, the first a tangible cost, the second an intangible cost. This discussion concerns the former. Compensation insurance is based upon 60 per cent representing the loss and 40 per cent the expense. The 40 per cent breaks down as 17.5 per cent acquisition of new business, 2.5 per cent to taxes, 2 per cent to inspection and safety, 2.5 per cent to payroll audits, 8 per cent claim expense and 7.5 per cent home office expense. Manner of arriving at both "manual rate" and "countrywide rates" is explained. The "manual rate" can be reduced by practical and successful safety programs and results in savings to the industry.

Intangible costs have been rated on the basis of 4 to 1. That is, for each dollar paid in direct compensation, medical attention, etc., through personal injury to an employee, the organization loses an additional four dollars. Management has no greater opportunity of expressing the human

side of itself and its employees than through a safety program. People like to work for an organization that stands for a sound, Christian-like fundamental such as safety. E.F.G.

PHYSIOLOGY

371. Concerning the Production of Alkaline Milk and of an Increase of the Iodine Index in the Fatty Matter in Milk Following Subcutaneous Injection of Dinitrophenol. E. BROUWER AND J. MARTIN, Exp. Sta., Dept. of Phys., Hoorn, Holland. Le Lait *18*, 174, p. 337, April, 1938.

After the subcutaneous injection of dinitrophenol in the goat, there was observed a production of alkaline milk (pH 7.67–7.75), and the carbon dioxide content also showed a marked increase (up to 98 volume per cent). In the butterfat, there was also an increase in the iodine index of about 15 units. The diminution of the feed furnished the animals analogously caused an increase in the iodine index because under such conditions the reserve fat is utilized for the production of fat in the milk. The pH and acidity of the milk from the goats on the reduced ration however remained normal. It is probable that when the dinitrophenol is injected, it is absence of foodstuffs (because of feverish conditions of the goats and diminished appetite) that causes the change in iodine index. After each injection of a significant quantity, the milk assumes a yellow color due to the presence in the milk serum of dinitrophenol either as such or modified. The significance of the results are discussed from the standpoint of the physiology of the goat. A.H.J.

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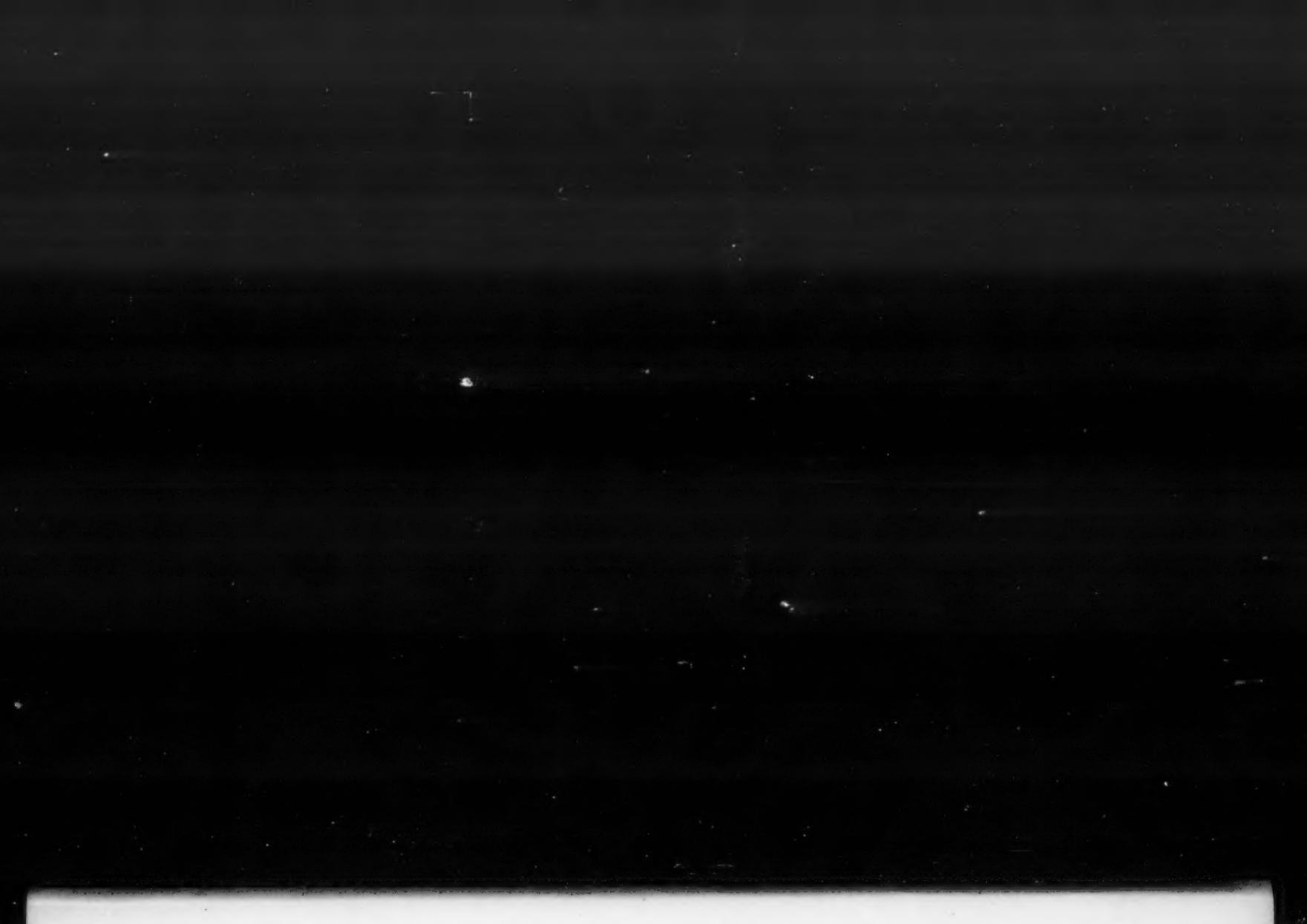

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